PUBLIC DOCUMENT . . . . No. 33.

NINTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

STATE AGRICULTURAL EXPERIMENT STATION

AT

AMHERST, MASS.

1891.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 Post Office Square.
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Commonwealth of Massachusetts.

Office of the Secretary, Boston, Jan. 14, 1892.

Hon. William E. Barrett, *Speaker of the House of Representatives.*

Sir: — I have the honor to transmit, for the use of the Legislature, the Ninth Annual Report of the Board of Control of the State Agricultural Experiment Station.

Very respectfully,

ISAAC H. EDGETT,
Deputy Secretary.

64369

Boston, Jan. 13, 1892.

To the Honorable Senate and House of Representatives.

In accordance with chapter 212 of the Acts of 1882 I have the honor to present the Ninth Annual Report of the Board of Control of the State Agricultural Experiment Station.

WM. R. SESSIONS,
Secretary.

MASSACHUSETTS STATE
AGRICULTURAL EXPERIMENT STATION,
AMHERST, MASS.

BOARD OF CONTROL, 1891.

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Governor of the Commonwealth, President ex officio.

D. A. HORTON of Northampton, ...	Term expires, 1892.
C. L. HARTSHORN of Worcester, ...	Term expires, 1894.

Appointed by the State Board of Agriculture.

J. H. DEMOND of Northampton, ...	Term expires, 1893.
T. P. ROOT of Barre, ...	Term expires, 1891.

Appointed by the Board of Trustees of the Massachusetts Agricultural College.

F. H. APPLETON of Peabody, ...	Term expires, 1892.

Appointed by the Massachusetts Society for Promoting Agriculture.

ELBRIDGE CUSHMAN of Lakeville, ...	Term expires, 1892.

Appointed by the Massachusetts State Grange.

WM. C. STRONG of Newton Highlands, . .	Term expires, 1894.

Appointed by the Massachusetts Horticultural Society.

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President of the Massachusetts Agricultural College.

C. A. GOESSMANN, Ph.D., LL.D., Amherst,
Director of the Station.

WM. R. SESSIONS, Hampden,
Secretary of the State Board of Agriculture.

WM. R. SESSIONS, Hampden,
Secretary and Auditor.

FRANK E. PAIGE, Amherst,
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STATION STAFF.

C. A. GOESSMANN, Ph.D., LL.D., *Director and Chemist*, . Amherst.

J. E. HUMPHREY, S.B., *Vegetable Physiologist (Mycologist)*, . Amherst.

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W. A. PARSONS, B.S., . .	*Field Experiments and Stock Feeding.*
DAVID WENTZELL, . . .	*Farmer.*

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* Resigned June 1, 1891.

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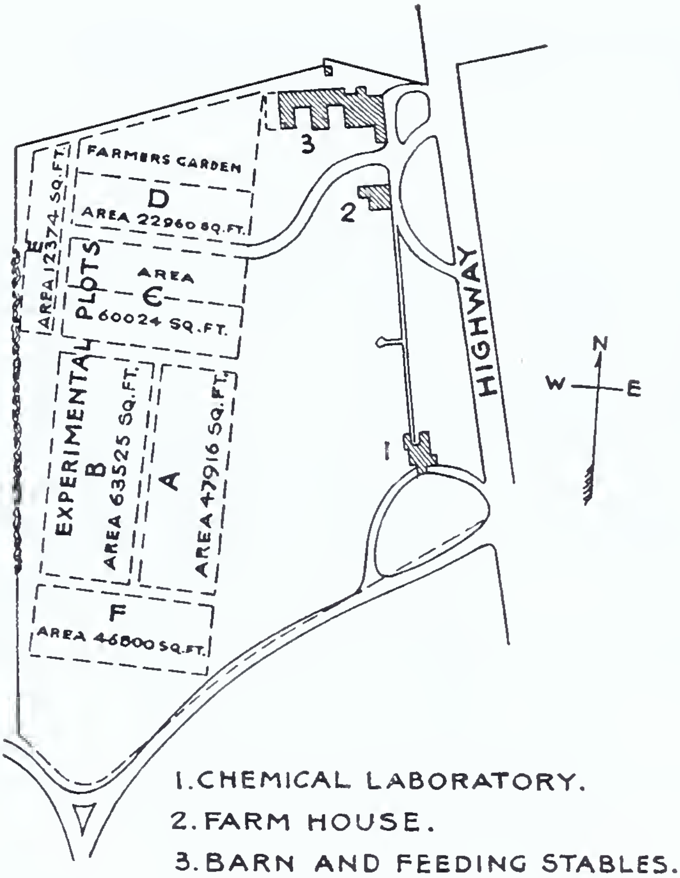
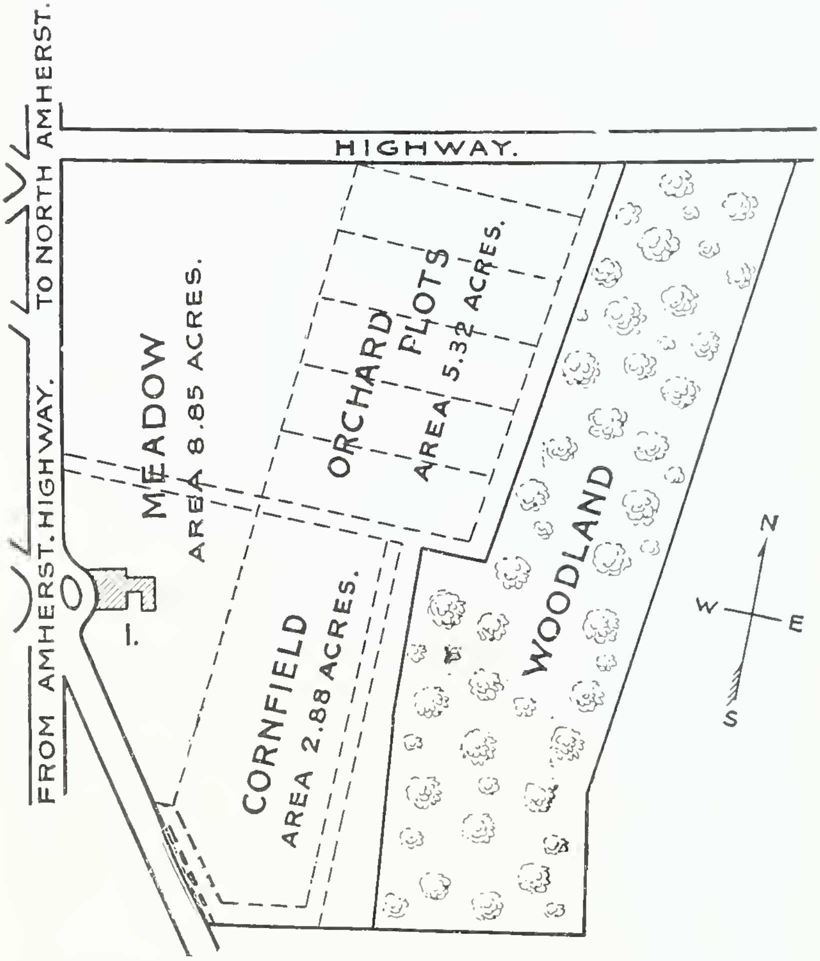


·MAP·OF·LAND·LEASED·TO·THE·
·MASSACHUSETTS·EXPERIMENT·STATION·
·FROM·THE·
·AGRICULTURAL·COLLEGE·FARM·
·WEST·OF·THE·HIGHWAY·
·AREA·TAKEN··17.72·ACRES·



I. AGRICULTURAL & PHYSIOLOGICAL LABORATORY.

MAP · OF · LAND · LEASED · TO · THE
MASSACHUSETTS · EXPERIMENT · STATION
· FROM · THE ·
AGRICULTURAL · COLLEGE · FARM
EAST · OF · THE · HIGHWAY
AREA · TAKEN · 30.52 · ACRES

NINTH ANNUAL REPORT OF THE DIRECTOR

OF THE

MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

To the Honorable Board of Control.

GENTLEMEN : — The past year has been a prosperous one in the history of the Massachusetts State Agricultural Experiment Station.

The buildings have suffered no injury from any exceptional source and are in a well-preserved state, considering their respective age and previous condition.

The construction of a new barn, for storing separately in a desirable manner the products of the different experimental plats, has filled a serious want.

A favorable season has aided materially in a successful termination of a variety of field experiments as well as in a satisfactory general management of the farm work.

The different lines of investigation presented from time to time for your consideration have received their due attention as far as circumstances have rendered practicable. The amount of work accomplished in the field, the barn and the chemical laboratory compares well with the results of previous years. The introduction of the vegetation house for the purpose of studying, under well-defined circumstances, the influence of special articles of plant food on the growth and character of plants, besides other intricate questions of vegetable physiology, has added an important feature to our resources of efficient methods of observation for the advancement of an economical production of farm crops.

Prof. J. E. Humphrey has continued his observations regarding various diseases of fruit-trees and garden crops. An interesting description of his investigation during the past year forms part of this report (Part II. 9).

The details of the work carried on during the past year, 1891, are reported upon subsequent pages in the following order : —

PART I.

ON FEEDING EXPERIMENTS — 1891.

I. FEEDING EXPERIMENTS WITH MILCH COWS (three).
II. FEEDING EXPERIMENTS WITH STEERS.
III. FEEDING EXPERIMENTS WITH LAMBS.
IV. FEEDING EXPERIMENTS WITH PIGS (three).

I.

Feeding Experiments with Milch Cows — 1891.

1. Feeding experiments with milch cows: Old-process linseed meal *vs.* gluten meal (Chicago).
2. Feeding experiment with milch cows: Gluten meal (Chicago) *vs.* cotton-seed meal and old-process linseed meal.
3. Summer feeding experiment with milch cows: Green feed, — vetch and oats, soja bean and fodder corn. Grain feed, — corn meal, gluten meal (Chicago), with dried brewers' grain *vs.* wheat bran.
4. Creamery record of the station for 1890 and 1891.
5. Fodder analyses and valuation of fodder.

PART II.

ON FIELD EXPERIMENTS, AND OBSERVATIONS IN VEGETABLE PHYSIOLOGY AND PATHOLOGY.

1. Effect of different kinds of nitrogen containing manurial substances on the yield of rye (Field A).
2. Experiments with prominent varieties of grasses and with grass mixtures to ascertain their comparative economical value under fairly corresponding circumstances (Field B).
3. Experiments with reputed fodder crops mostly new to our locality, and with a series of garden crops treated with different mixtures of commercial fertilizing ingredients (Field C).
4. Experiments with raising Stowell's evergreen sweet corn for ensilage (Field D).
5. Experiments with different commercial phosphates to study the economy of using natural phosphates or acidulated phosphates in farm practice (Field F).

6. Experiment with a Western variety of dent corn, Pride of the North, for ensilage (Field G).
7. Experiments with grass lands (meadows).
8. Report on general farm work in 1891.
9. Report of Prof. James Ellis Humphrey on plant diseases, etc., with observations in the field and in the vegetation house.

PART III.

SPECIAL WORK IN THE CHEMICAL LABORATORY.

I. Communication on commercial fertilizers: —
   1. General introduction.
   2. Laws for the regulation of the trade in commercial fertilizers.
   3. List of licensed manufacturers.
   4. Analyses of licensed fertilizers.
   5. Analyses of commercial fertilizers and manurial substances sent on for examination.
   6. Miscellaneous analyses.

II. Water analyses.

III. Compilation of analyses made at Amherst, Mass., of agricultural chemicals and refuse materials used for fertilizing purposes.

IV. Compilation of analyses made at Amherst, Mass., of fodder articles, fruits, sugar-producing plants, dairy products, etc.

Meteorological Observations.

The periodical publications of the station have been as numerous as during previous years. The applications for copies of bulletins and annual reports are steadily increasing. Our supply of bulletins I to XXX and of annual reports I to VI is exhausted.

In concluding this communication it gives me pleasure to acknowledge the industry and faithful assistance of all parties associated with me in the task assigned. With sincere thanks for your kind support and indulgence allow me to sign,

Yours very respectfully,

C. A. GOESSMANN,

Director of the Massachusetts State Agricultural Experiment Station.

PART I.

ON

FEEDING EXPERIMENTS,

1891.

I. Feeding Experiments with Milch Cows (three).
II. Feeding Experiments with Steers.
III. Feeding Experiments with Lambs.
IV. Feeding Experiments with Pigs (three).

I.

FEEDING EXPERIMENTS WITH MILCH COWS.

1891.

General introduction to our late feeding experiments with milch cows.
I. Feeding experiment with milch cows: Old-process linseed meal *vs.* gluten meal (Chicago variety).
II. Feeding experiment with milch cows: Gluten meal (Chicago variety) *vs.* cotton-seed meal and old-process linseed meal.
III. Summer feeding experiment with milch cows: Green feed, — vetch and oats, soja bean and fodder corn. Grain feed, — corn meal, gluten meal (Chicago variety), with dried brewers' grain *vs.* wheat bran.
IV. Creamery record of the station for 1890 and 1891, with a description of modes of analysis.
V. Analysis of fodder and valuation of fodder.

General Introduction. — In summing up in our late annual report the principal results obtained in connection with a series of feeding experiments with milch cows, carried on from 1885 to 1889 at the Massachusetts State Agricultural Experiment Station, special attention was called to the fact that until quite recently our main object has been to compare the economical value of some of our most prominent current *home-raised coarse fodder articles* when used for dairy purposes. English hay, rowen (hay of second cut of upland meadows), dry fodder corn, corn stover, corn ensilage and several varieties of roots (sugar beets and carrots) were the fodder articles of that description used. They were fed as far as practicable under otherwise corresponding circumstances.

To attain this end it became necessary to use in all cases alike the same kinds and the same quantities of grain feed in compounding the daily diet of the cows on trial. The selection among the various kinds of grain feed for the daily diet was, for obvious reasons, confined to but a few, — viz., corn meal or corn and cob meal, wheat bran and gluten meal (Chicago variety). (See Eighth Annual Report, pages 12–15.) These articles were at any time, in sufficient quantity and of good quality, at our disposal; they all enjoyed a fair reputation of fitness for milk production.

Having made ourselves, by actual trial, to a certain degree familiar with the comparative feeding effect and the special economical merits of the above-stated coarse fodder articles under specified conditions, *it was decided to institute a new series of feeding experiments with milch cows for the special purpose of studying the feeding effect and the general economy of some of our most prominent concentrated commercial feed stuffs, as old and new process linseed meal, cotton-seed meal and gluten meal, when fed in equal weights in place of each other and in connection with the same kinds of fine and coarse fodder articles.*

The results of one experiment, which was planned to ascertain the comparative merits of old and new process linseed meal as constituents of the daily diet of milch cows, under otherwise corresponding circumstances, has been already published in Bulletin 38, and in our last annual report, pages 15–24.

Three more recent experiments of a similar character, with Chicago gluten meal and old-process linseed meal, with Chicago gluten meal and cotton-seed meal, and with dried brewers' grain and wheat bran, are reported within a few subsequent pages, marked 1, 2, 3.

1. *Feeding Experiment with Milch Cows.*

Old-process linseed meal *vs.* gluten meal (Chicago variety), Oct. 21 to Dec. 31, 1889.

This feeding experiment was instituted as above intimated for the special purpose of comparing the effect of old-process linseed meal with that of gluten meal on the cost of feed and on the yield of milk, when fed in equal weights as substitutes of each other in connection with the same kinds and the same quantities of coarse and fine fodder articles. Six cows, grades, served in the trial; the observation lasted from ten to twelve weeks.

1. *History of Cows.*

NAME.	Breed.	Age (Years).	Last Calf dropped.	Daily Yield of Milk at beginning of Trial (Quarts).	Number of Months on Trial.
Juno, .	Grade Ayrshire, .	7	June 22, 1889,	11–12	2½
Flora, .	Grade Durham, .	6	Dec. 22, 1888,	9–10	2½
Eva, . .	Grade Jersey, .	10	Oct. 7, 1888,	7–8	2½
Elsie, .	Grade Holstein, .	7	Feb 26, 1889,	7–8	2½
Jessie, .	Grade Jersey, .	6	Jan. 12, 1889,	8–9	2½
Annie, .	Grade Jersey, .	7	June 19, 1888,	8–9	2½

The cows thus far used in all our feeding experiments for the production of milk have been grades of more or less uncertain parentage. We secure them usually on the condition that they are new milch cows, from one to two weeks after calving when bought, and of fair milking quality, yielding from fifteen to sixteen quarts per day at this time. They serve usually in the trials until their daily yield of milk becomes unprofitable, from five to six quarts, when they are replaced by new milch cows.

2. *Description of Fodder Articles.*

The general character and chemical composition of the different fodder ingredients used in the preparation of the daily diet may be seen from the following statement: —

	Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Hay.
Moisture at 100° C., . .	11.67	9.27	9.80	9.88	9.72
Dry matter, ...	88.33	90.73	90.20	90.12	90.28
	100.00	100.00	100.00	100.00	100.00
Analyses of Dry Matter.					
Crude ash, ...	1.89	7.47	1.25	7.39	6.43
" cellulose, ...	1.44	9.75	1.75	8.74	32.28
" fat, ...	4.44	5.48	7.00	7.24	2.49
" protein, ...	10.46	17.53	31.25	36.97	9.54
Non-nitrogenous matter, .	81.77	59.77	58.75	39.66	49.26
	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents contained in the Various Fodder Articles used.

	Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Hay.
Moisture at 100° C.,	11.67	9.27	9.80	9.88	9.72
Nitrogen,	1.479	2.545	4.510.	5.331	1.379
Phosphoric acid,	0.713	2.900	0.392	1.646	0.359
Potassium oxide,	0.430	1.637	0.049	1.162	1.572

3. *Mode of Feeding.*

The daily fodder rations contained per head throughout the entire experiment three and one-fourth pounds of corn meal and three and one-fourth pounds of wheat bran, with either three and one-fourth pounds of gluten meal (Chicago variety) or three and one-fourth pounds of old-process linseed meal as grain feed ration. A fair quality of English hay, first cut of upland meadows, served as the sole coarse feed during the entire experiment. The daily ration of hay was controlled by the appetite of each cow engaged in the trial. It varied from eighteen to twenty-two pounds per head in case of different animals.

One-half the above-stated grain feed ration was fed with some hay at the time of milking in the morning and the other half in a similar way during milking in the evening. The remainder of the hay was given at noon and after milking in the evening. Water was offered twice daily, as a rule, one and one-half to two hours after feeding the grain feed.

The daily fodder rations described farther on represent the *average composition* of the daily diet per head during the different succeeding feeding periods. The calculation of the cost of the daily fodder rations below stated is based on the contemporary local market price of the various fodder articles used in their combination.

Local Market Cost of the Various Fodder Articles used from Oct. 21 to Dec. 31, 1889.

	Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Hay.
Per 2,000 pounds,	$19 00	$17 50	$23 00	$27 00	$15 00
Per pound (cents),	0.95	0.875	1.15	1.35	0.75

Commercial Value of the Essential Fertilizing Constituents contained in the Above Fodder Articles.

Nitrogen, 17 cents; phosphoric acid, 6 cents; potassium oxide, 4½ cents.

Moisture at 100° C.,	11.67	9.27	9.80	9.88	9.72
Nitrogen,	1.479	2.545	4.510	5.331	1.379
Phosphoric acid,	.713	2.900	0.392	1.646	0.359
Potassium oxide,	.430	1.637	0.049	1.162	1.572
Valuation per 2,000 pounds,	$6 27	$13 60	$15 85	$21 15	$6 53

Obtainable Manurial Value (per Ton), allowing a Loss of 20 Per Cent. contained in the Milk sold.

	$5 02	$10 88	$12 68	$16 92	$5 22

Net Cost of Above Fodder Articles per 2,000 Pounds (obtained by deducting the Obtainable 80 Per Cent. of Manurial Value from their Market Cost).

	$13 98	$6 62	$10 32	$10 08	$9 78

Net Cost per Pound (Cents).

	0.699	0.331	0.516	0.504	0.489

Average Composition of the Daily Fodder Rations used during Different Periods of the Experiment.

I. and II.

Corn meal,	3.25	lbs.
Wheat bran,	3.25	"
Gluten meal,	3.25	"
Hay,	19.50	"
Total cost,	24.30	cts.
Net cost,	14.64	"
Manurial value obtainable,	9.66	"
Nutritive ratio,	1 : 6.35	

Average Composition, etc. — Concluded.

III.

Corn meal,	3.25 lbs.
Wheat bran,	3.25 "
Old-process linseed meal,	3.25 "
Hay,	18.50 "
Total cost,	24.18 cts.
Net cost,	14.06 "
Manurial value obtainable,	10.12 "
Nutritive ratio,	1:5.73

Summary of the Cost of the Daily Fodder Rations.

	PERIODS.		
	I.	II.	III.
	Cents.	Cents.	Cents.
Market cost,	24.30	24.30	24.18
Manurial value obtainable,	9.66	9.66	10.12
Net cost,	14.64	14.64	14.06

4. *Valuation of Feed.*

The commercial valuation of the feed stuffs used in the above-described fodder rations is based on their market price per ton of 2,000 pounds at Amherst during the time occupied by the experiment here under discussion, October, 1889, to January, 1890. The market cost of wheat bran, gluten meal and, in particular, of corn meal has since in an exceptional degree advanced, while that of old-process linseed meal and of English hay has remained materially the same. Accepting the above-stated market prices as well as the chemical analysis of the different fodder articles as the basis for our financial calculation we find that the market cost of the daily grain feed rations (periods I., II.), consisting of corn meal and wheat bran with gluten meal, three and one-fourth pounds each, amounts to 9.67 cents, while in case of a corresponding quantity of corn meal, wheat bran and old-process linseed meal it amounts to 10.32 cents, a difference of 0.63 cents in favor of the gluten meal containing daily grain feed ration.

Allowing on the other hand in our calculation the commercial value of 80 per cent. of the nitrogen, phosphoric acid and potassium oxide contained in the grain feed constituents of the different daily fodder rations as obtainable in form of the manurial refuse, we notice that the higher market price of the old-process linseed meal ($27 per ton) as compared with that of the gluten meal ($23 per ton), a difference of four dollars in favor of the latter, is practically offset by the higher commercial value of the manurial refuse obtained when feeding old-process linseed meal, pound for pound, in place of gluten meal in connection with an otherwise corresponding daily diet of milch cows. The net cost of the gluten meal containing daily grain feed ration (periods I., II.) amounts per head to 5.03 cents, while that of the old-process linseed meal containing grain feed portion of the daily fodder rations (period III.) amounts to 4.99 cents, a difference of 0.04 cents in favor of the latter, too small an amount to deserve serious consideration from a commercial stand-point.

Average Quantity of Milk per Day (Quarts).

[1 quart = 2.15 pounds.]

FEEDING PERIODS.	Juno.	Flora.	Eva.	Elsie.	Jessie.	Annie.
I.,	11.63	9.87	7.37	7.70	8.37	8.06
II.,	11.27	9.11	7.14	7.42	8.23	7.55
III.,	9.67	8.64	6.28	7.07	7.87	6.90
Average,	10.85	9.21	7.27	7.39	8.16	7.50

An examination of the above-stated average daily yield of milk in case of different cows shows a gradual decline from period to period. The decline in the daily yield of milk of the second period, as compared with that of the first period, varies in case of different cows from .14 to .76 quarts and averages per head 0.4 quarts for the entire herd. The difference in the decline of the daily yield of milk, when substituting pound for pound old-process linseed meal for gluten meal in the daily diet (period III.), is as a rule more marked and less uniform, as far as different animals are concerned, than will be noticed when comparing first and second feeding periods in the stated direction. The actual decline in average daily yield of milk when passing from II. into III. period varies in case of different cows from .35 to 1.6 quarts, and amounts to .71 quarts per head in case of the entire herd.

	I.*	II.†
Juno,	11.63 — 9.67	10.85
Flora,	9.87 — 8.64	9.21
Eva,	7.39 — 6.28	6.93
Elsie,	7.70 — 7.07	7.39
Jessie,	8.37 — 7.87	8.15
Annie,	8.06 — 6.90	7.50

* Variations in daily production of milk during the entire feeding experiment (quarts).

† Average quantity of milk per day for the entire feeding experiment (quarts).

Analyses of Milk (Per Cent.).

Juno.

	Oct. 15.	Dec. 4.	Dec. 17.	Dec. 24.	Dec. 31.
Solids,	13.22	13.16	12.61	12.25	13.68
Fat,	4.03	3.56	3.75	3.62	4.33
Solids not fat,	9.19	9.60	8.86	8.63	9.35

Flora.

	Oct. 15.	Dec. 4.	Dec. 17.	Dec. 24.	Dec. 31.
Solids,	13.35	14.04	13.68	13.38	13.36
Fat,	4.10	4.18	3.92	3.92	3.33
Solids not fat,	9.25	9.86	9.76	9.46	10.03

Eva.

	Oct. 15.	Dec. 4.	Dec. 17.	Dec. 24.	Dec. 31.
Solids,	16.25	16.88	17.65	16.70	16.92
Fat,	6.10	6.18	6.18	6.18	6.15
Solids not fat,	10.15	10.70	11.47	10.52	10.77

Analyses of Milk (Per Cent.) — Concluded.

Elsie.

	Oct. 15.	Dec. 4.	Dec. 17.	Dec. 24.	Dec. 31.
Solids, ...	12.82	13.42	12.55	12.80	13.00
Fat, ...	3.55	3.92	3.65	4.08	4.00
Solids not fat, . . .	9.27	9.32	8.90	8.72	9.00
Jessie.					
Solids, ...	14.74	14.96	15.08	14.96	14.12
Fat, ...	5.33	5.46	5.40	5.32	4.90
Solids not fat, . . .	9.41	9.50	9.68	9.64	9.22
Annie.					
Solids, ...	15.68	15.44	14.80	13.68	14.88
Fat, ...	5.18	5.24	5.29	3.77	5.11
Solids not fat, . . .	10.50	10.20	9.51	9.91	9.77

Live Weight of Animals during the Feeding Periods (Pounds).

FEEDING PERIODS.	NAME OF COW.					
	Juno.	Flora.	Eva.	Elsie.	Jessie.	Annie.
I, ...	1,064	980	1,086	1,200	868	954
II., ...	1,089	992	1,098	1,207	880	969
III., ...	1,070	1,000	1,092	1,220	888	981
Gain at close, . .	6	20	6	20	20	27

Conclusions. — The previously stated results of our inquiry into the comparative merits of gluten meal (Chicago variety) and of old-process linseed meal as constituents of the daily diet of milch cows lead us to the following conclusions: 1. The substitution of three and one-fourth pounds of gluten meal (Chicago variety) by the same weight of old-process linseed meal at stated local market prices, and under otherwise corresponding circumstances, raises the market cost of the daily fodder ration per head 0.65 cents. Taking in both instances the obtainable manurial value (80 per cent.) into consideration, the old-process linseed meal proves, in our case, 0.04 cents cheaper than gluten meal. The higher manurial value of the old-process linseed meal as compared with our sample of gluten meal fairly equals the difference in the local market cost of both articles. 2. The Chicago gluten meal leads in our case the old-process linseed meal in every instance, as far as the nutritive effect of both is concerned. The difference is not great, yet worthy of special notice under stated market conditions. 3. The quality of the milk as far as its density is concerned shows no marked difference during the entire experiment.

FEEDING RECORD.

1. *Juno.*

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY. Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Hay.	Amount of Dry Vegetable Matter in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
1889.										
Oct. 21 to Nov. 10, ...	3.25	3.25	3.25	–	21.90	28.52	11.63	2.45	1:6.51	1,064
Nov. 13 to Dec. 3, ...	3.25	3.25	3.25	–	21.81	28.42	11.27	2.52	1:6.51	1,089
Dec. 11 to Dec. 31, ...	3.25	3.25	–	3.25	18.95	25.84	9.67	2.67	1:5.76	1,070

2. *Flora.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Hay.	Amount of Dry Vegetable Matter in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
Oct. 21 to Nov. 10, ...	3.25	3.25	3.25	–	17.90	24.91	9.87	2.52	1:6.25	980
Nov. 13 to Dec. 3, ...	3.25	3.25	3.25	–	18.86	25.78	9.11	2.83	1:6.31	992
Dec. 11 to Dec. 31, ...	3.25	3.25	–	3.25	19.43	26.27	8.64	3.04	1:5.79	1,000

3. *Eva.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Hay.	Amount of Dry Vegetable Matter in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
Oct. 21 to Nov. 10, ...	3.25	3.25	3.25	–	18.86	25.78	7.39	3.49	1:6.31	1,086
Nov. 13 to Dec. 3, ...	3.25	3.25	3.25	–	19.71	26.54	7.14	3.72	1:6.37	1,098
Dec. 11 to Dec. 31, ...	3.25	3.25	–	3.25	18.19	25.15	6.28	4.00	1:5.70	1,092

4. Elsie.

Oct. 21 to Nov. 10, ...	3.25	3.25	3.25	–	19.33	25.83	7.70	3.35	1:6.34	1,200
Nov. 13 to Dec. 3, ...	3.25	3.25	3.25	–	18.95	25.86	7.42	3.49	1:6.32	1,207
Dec. 11 to Dec. 31, ...	3.25	3.25	–	3.25	17.93	24.92	7.07	3.52	1:5.68	1,220

5. Jessie.

Oct. 21 to Nov. 10, ...	3.25	3.25	3.25	–	19.43	26.28	8.37	3.14	1:6.35	868
Nov. 13 to Dec. 3, ...	3.25	3.25	3.25	–	19.62	26.45	8.23	3.21	1:6.36	880
Dec. 11 to Dec. 31, ...	3.25	3.25	–	3.25	18.40	25.37	7.87	3.22	1:5.72	888

6. Annie.

Oct. 21 to Nov. 10, ...	3.25	3.25	3.25	–	17.62	24.65	8.06	3.06	1:6.24	954
Nov. 13 to Dec. 3, ...	3.25	3.25	3.25	–	17.95	24.95	7.55	3.30	1:6.25	969
Dec. 11 to Dec. 31, ...	3.25	3.25	–	3.25	17.69	24.70	6.90	3.58	1:5.66	981

TOTAL COST OF FEED PER QUART OF MILK.

Juno.

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Old-process Linseed Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Hay consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents)
1889.									
Oct. 21 to Nov. 10, ...	244.19	11.63	68.25	68.25	–	68.25	460.00	$5 48	2.24
Nov. 13 to Dec. 3, ...	236.74	11.27	68.25	68.25	–	68.25	458.00	5 47	2.31
Dec. 11 to Dec. 31, ...	203.02	9.67	68.25	–	68.25	68.25	398.00	5 16	2.54

Flora.

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Old-process Linseed Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Hay consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents)
Oct. 21 to Nov. 10, ...	207.21	9.87	68.25	68.25	–	68.25	376.00	$4 85	2.34
Nov. 13 to Dec. 3, ...	191.28	9.11	68.25	68.25	–	68.25	396.00	5 00	2.61
Dec. 11 to Dec. 31, ...	181.50	8.64	68.25	–	68.25	68.25	408.00	5 23	2.88

Eva.

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed.	Total Amount of Gluten Meal consumed.	Total Amount of Old-process Linseed Meal consumed.	Total Amount of Wheat Bran consumed.	Total Amount of Hay consumed.	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents)
Oct. 21 to Nov. 10, ...	155.23	7.39	68.25	68.25	–	68.25	396.00	$5 00	3.22
Nov. 13 to Dec. 3, ...	149.88	7.14	68.25	68.25	–	68.25	414.00	5 14	3.43
Dec. 11 to Dec. 31, ...	131.86	6.28	68.25	–	68.25	68.25	382.00	5 04	3.82

					Elsie.				
Oct. 21 to Nov. 10, ...	161.63	7.70	68.25	68.25	–	68.25	406.00	$5 08	3.14
Nov. 13 to Dec. 3, ...	155.81	7.42	68.25	68.25	–	68.25	398.00	5 02	3.22
Dec. 11 to Dec. 31, ...	148.49	7.07	68.25	–	68.25	68.25	376.50	4 99	3.36
					Jessie.				
Oct. 21 to Nov. 10, ...	175.81	8.37	68.25	68.25	–	68.25	408.00	$5 09	2.90
Nov. 13 to Dec. 3, ...	172.91	8.23	68.25	68.25	–	68.25	412.00	5 12	2.96
Dec. 11 to Dec. 31, ...	165.35	7.87	68.25	68.25	68.25	–	386.50	5 07	3.08
					Annie.				
Oct. 21 to Nov. 10, ...	169.30	8.06	68.25	68.25	–	68.25	370.00	$4 81	2.84
Nov. 13 to Dec. 3, ...	158.60	7.55	68.25	68.25	–	68.25	374.00	4 84	3.05
Dec. 11 to Dec. 31, ...	145.00	6.90	68.25	68.25	68.25	–	371.50	4 96	3.42

NET COST OF MILK AND MANURIAL VALUE OF FEED.

Juno.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1889.					Cents.	Pounds.
Oct. 21 to Nov. 10, .	$5 48	$2 72	$2 18	$3 30	1.35	1,085
Nov. 13 to Dec. 3, .	5 47	2 71	2 17	3 30	1.39	1,095
Dec. 11 to Dec. 31, .	5 16	2 69	2 15	3 01	1.48	1,034

Flora.

Oct. 21 to Nov. 10, .	$4 85	$2 45	$1 96	$2 89	1.39	980
Nov. 13 to Dec. 3, .	5 00	2 51	2 01	2 99	1.56	990
Dec. 11 to Dec. 31, .	5 23	2 72	2 18	3 05	1.68	1,015

Eva.

Oct. 21 to Nov. 10, .	$5 00	$2 51	$2 01	$2 99	1.93	1,085
Nov. 13 to Dec. 3, .	5 14	2 57	2 06	3 08	2.05	1,118
Dec. 11 to Dec. 31, .	5 04	2 63	2 10	2 94	2.23	1,098

Elsie.

Oct. 21 to Nov. 10, .	$5 08	$2 50	$2 00	$3 08	1.85	1,200
Nov. 13 to Dec. 3, .	5 02	2 52	2 02	3 00	1.93	1,200
Dec. 11 to Dec. 31, .	4 99	2 62	2 10	2 89	1.95	1,220

Jessie.

Oct. 21 to Nov. 10, .	$5 09	$2 51	$2 01	$3 08	1.75	865
Nov. 13 to Dec. 3, .	5 12	2 53	2 02	3 10	1.79	880
Dec. 11 to Dec. 31, .	5 07	2 65	2 12	2 95	1.79	875

Annie.

Oct. 21 to Nov. 10, .	$4 81	$2 39	$1 91	$2 90	1.71	965
Nov. 13 to Dec. 3, .	4 84	2 40	1 92	2 92	1.84	980
Dec. 11 to Dec. 31, .	4 96	2 61	2 09	2 87	1.98	983

Analyses of Fodder Articles used in the Experiment.

Corn Meal (Average).

1889-1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	11.67	233.40	–	–	1 : 9.65
Dry matter, . . .	88.33	1,766.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...					
" cellulose, . . .	1.89	37.80	–	–	
" fat, ...	1.44	28.80	9.79	34	
" protein (nitrogenous	4.44	88.80	67.49	76	
matter), . .	10.46	209.20	177.82	85	
Non-nitrogenous extract					
matter, ...	81.77	1,635.40	1,537.28	94	
	100.00	2,000.00	1,792.38	–	

Gluten Meal.

1889-1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	9.80	186.00	–	–	1 : 2.60
Dry matter, . . .	90.20	1,804.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.25	25.00	–	–	
" cellulose, . . .	1.75	35.00	11.90	34	
" fat, ...	7.00	140.00	106.40	76	
" protein (nitrogenous matter), . .	31.25	625.00	531.25	85	
Non-nitrogenous extract matter, ...	58.75	1,175.00	1,104.50	94	
	100.00	2,000.00	1,754.05	–	

Old-process Linseed Meal (Average).

1889-1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.88	197.60	–	–	1 : 1.70
Dry matter,	90.12	1,802.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.39	147.80	–	–	
" cellulose,	8.74	174.80	45.45	26	
" fat,	7.24	144.80	131.77	91	
" protein (nitrogenous matter),	36.97	739.40	643.28	87	
Non-nitrogenous extract matter,	39.66	793.20	721.81	91	
	100.00	2,000.00	1,542.31	–	

Hay (Average).

1889-1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.72	194.40	–	–	1 : 9.68
Dry matter,	90.28	1,805.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.43	128.60	–	–	
" cellulose,	32.28	645.60	374.45	58	
" fat,	2.49	49.80	22.91	46	
" protein (nitrogenous matter),	9.54	190.80	108.76	57	
Non-nitrogenous extract matter,	49.26	985.20	620.68	63	
	100.00	2,000.00	126.80	–	

2. *Feeding Experiment with Milch Cows.*

Gluten meal (Chicago variety) *vs.* cotton-seed meal and old-process linseed meal, November, 1890, to June 1891.

Below are briefly recorded the results of observations with cotton-seed meal and old-process linseed meal when fed as substitutes for gluten meal (Chicago variety) in an otherwise corresponding daily diet of milch cows. The experiment was instituted, as has been intimated above, mainly for the purpose of comparing the effect of cotton-seed meal and old-process linseed meal with that of gluten meal (Chicago variety) on the cost of the feed consumed and on the quantity and the quality of the milk produced, when fed each in equal weight as an ingredient of an otherwise corresponding daily diet of milch cows.

1. *History of Cows.*

Nine cows, grades of various descriptions and of different milking periods, served in the trial.

NAME OF COW.	Breed.	Age (Years).	Last Calf dropped.	Daily Yield of Milk at beginning of Trial (Quarts).	Number of Months on Trial.
1. Jessie, . .	Grade Jersey, .	7	Jan. 12, 1889,	6–7	5–6
2. Pearl, . .	Native, . .	6	Aug. 8, 1890,	10–11	7
3. Pink, . .	Native, . .	7	Jan. 23, 1890,	7–8	7
4. Roxy, . .	Grade Ayrshire,	7	Feb. 5, 1890,	6–7	2½
5. Buttercup, .	Grade Ayrshire,	5	Jan. 2, 1891,	13–14	4
6. Nancy, .	Native, . .	8	March 16, 1890,	8–9	4
7. Clarissa, .	Grade Durham,	7	March 18, 1891,	9–10	2
8. Juno, . .	Grade Ayrshire,	7	June 22, 1889,	7–8	3
9. Favorite, .	Grade Durham,	6	Feb. 20, 1891,	11–12	3

2. *Description of Fodder Articles.*

The daily fodder rations contained per head throughout the entire experiment, as fine or grain feed, three pounds of corn meal and three pounds of wheat bran; to these were added for stated reasons at different stages of the observation, per head, either three pounds of gluten meal, or three pounds of old-process linseed meal, or three pounds of cotton-seed meal to complete the daily ration of grain or fine feed.

The general character of the various kinds of grain feed used in the daily diet may be seen from the following analyses of the different articles of grain feed used: —

	Corn Meal.	Wheat Bran.	Cotton-seed Meal.	Old-process Linseed Meal.	Gluten Meal.
Moisture at 100° C., . .	13.26	12.11	9.77	8.72	10.90
Dry matter, ...	86.74	87.89	90.23	91.28	89.10
	100.00	100.00	100.00	100.00	100.00
Analyses of Dry Matter.					
Crude ash, ...	1.72	7.40	8.18	5.96	1.02
" cellulose, . .	2.28	12.17	7.74	8.23	1.28
" fat, ...	4.90	5.04	11.33	9.87	7.36
" protein, . . .	12.94	18.48	44.41	36.19	34.79
Non-nitrogenous matter, .	78.16	56.91	28.34	39.75	55.55
	100.00	100.00	100.00	100.00	100.00

Fertilizing Constituents of the Above Fodder Articles.

Nitrogen, 15 cents per pound; phosphoric acid, 5½ cents; potassium oxide, 4½ cents.

	Corn Meal.	Wheat Bran.	Cotton-seed Meal.	Old-process Linseed Meal.	Gluten Meal.
Moisture, ...	13.26	12.11	9.77	8.72	10.90
Nitrogen, ...	1.796	2.599	6.412	5.285	4.959
Phosphoric acid, . . .	.707	2.845	2.333	1.780	.425
Potassium oxide, . . .	.435	1.625	1.723	1.214	.045
Valuation per 2,000 pounds,	$6 56	$12 39	$23 36	$18 90	$15 38

The coarse feed used in compounding the daily diet in this connection consisted either of nothing but rowen, — hay of second cut of upland meadows, — or of rowen and a mixed ensilage, consisting of equal weights of green fodder corn and of green soja bean, or of nothing but corn stover. The same variety of dent corn, "Pride of the North," furnished the green fodder corn for the mixed ensilage and for the corn stover. The corn stover was obtained from the fully matured corn, while the corn used for the mixed ensilage had reached the stage of growth when the kernels begin to glaze.

The soja bean when used for ensilage had finished its growth and showed a liberal formation of seed pods. In both instances the entire plant was cut a few inches above ground.

The corn, — stalks, ears and leaves, — was reduced to pieces of from one to one and one-half inches in length, and the soja bean, — entire plant, — being still soft and succulent in the stated period of growth, was merely cut into two or three pieces. Both plants thus prepared were subsequently filled alternately, in layers one foot in thickness, into a silo. The filling of the silo was carried on as fast as the material could be conveniently secured. Each layer was carefully packed down and the whole finally covered with layers of tar paper and matched boards. The latter were held in place by barrels filled with sand. The silo was filled at the beginning of September, 1890, and opened for use during the succeeding January.

The mixed ensilage thus produced was of a yellowish green color, and less acid than a clear corn ensilage obtained from the same lot of fodder corn treated in the same manner and at the same time in an adjoining silo. The influence which in our case an addition of an equal weight of a nearly matured soja bean exerts on the composition of corn ensilage will be seen from a comparison of the following analyses of the two kinds of ensilage, No. 1 and No. 2.

The clear corn ensilage, No. 1, was obtained from the same lot of fodder corn which served for the production of the above-described mixed ensilage, No. 2. The silos were in both cases filled in the same way, and as far as practicable at the same time. They were of a corresponding size and contained fairly even quantities of vegetable matter. Both were opened for general use at about the same time, four months after filling. The samples that served for the analyses represent in each case the average of the ensilage obtained by cutting in a vertical direction through the contents of each silo.

Analyses of Dry Matter.

	No. 1. Corn Ensilage.	No. 2. Corn and Soja Bean Ensilage.
	Per Cent.	Per Cent.
Crude ash,	6.73	11.04
" cellulose,	26.90	27.84
" fat,	3.27	5.35
" protein,	8.97	15.27
Non-nitrogenous matter,	54.13	40.50
	100.00	100.00

The composition of the dry vegetable matter of the mixed ensilage, No. 2, compares well with that of a medium quality of red clover hay.

The successful cultivation of the soja bean upon the fields of the Massachusetts State Agricultural Experiment Station has been repeatedly pointed out in previous annual reports. The superior feeding effect of green soja bean as a coarse fodder constituent in the diet of milch cows has been shown in our summer feeding experiments of 1890. (See Eighth Annual Report, pages 39 to 54.) Our experience this year confirms our previous statement. The high economical value of this reputed fodder crop finds again a striking illustration in the experiment reported in detail upon some succeeding pages.

The general character of the different coarse fodder articles used on this occasion will be seen from the subsequent statement.

Fodder Analyses of the Different Coarse Fodder Articles used.	Rowen.	Corn and Soja Bean Ensilage.	Corn Stover.
Moisture at 100° C.,	13.90	71.03	19.89
Dry matter,	86.10	28.97	80.11
	100.00	100.00	100.00
Analyses of Dry Matter.			
Crude ash,	8.28	11.04	6.33
" cellulose,	28.88	27.84	34.59
" fat,	3.91	5.35	1.28
" protein,	13.45	15.27	5.74
Non-nitrogenous extract matter,	45.48	40.50	52.06
	100.00	100.00	100.00

Fertilizing Constituents.

Nitrogen, 15 cents per pound; phosphoric acid, 5½ cents; potassium oxide, 4½ cents.

MANURIAL CONSTITUENTS IN THE ABOVE-STATED COARSE FEED STUFFS.	Rowen.	Corn and Soja Bean Ensilage.	Corn Stover.
Moisture,	13.90	71.03	19.89
Nitrogen,	1.853	.708	.735
Phosphoric acid,	.464	.420	.259
Potassium oxide,	1.966	.444	1.235
Valuation per 2,000 pounds,	$7 84	$2 98	$3 60

3. *Mode of Feeding.*

The daily grain feed ration contained per head throughout the entire experiment three pounds of corn meal and three pounds of wheat bran. To these were added, per head, at different stages of our observation, either three pounds of gluten meal, or three pounds of old-process linseed meal, or three pounds of cotton-seed meal, to complete the grain feed part of the daily diet. One-half of the grain feed was fed with some of the coarse feed at the time of milking in the morning and the other half in a similar way during milking in the evening. The remainder of the coarse fodder was given at noon and after milking in the evening.

The consumption of the coarse fodder constituents of daily diet, as far as quantity is concerned, was in most instances controlled by the appetite of each animal. To satisfy the latter, a small excess was offered and the remaining portion subsequently weighed back. This practice was adopted, in particular, in case of rowen when fed alone as coarse feed, and in case of mixed ensilage and of corn stover. Five pounds of rowen, however, were always fed per day to each cow whenever the mixed ensilage of corn and soja bean formed a prominent part of their daily diet. The daily fodder rations, which are described below in detail, represent the *average composition* of the daily diet used, per head, during the different succeeding feeding periods.

The subsequent record of the cost of the different fodder ingredients used in the daily fodder ration can assist in recognizing the basis for our calculations of the cost of the latter.

Local Market Cost of the Various Fodder Articles used from November, 1890, to June, 1891.

	Corn Meal.	Wheat Bran.	Cotton-seed Meal.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn and Soja Bean Ensilage.	Corn Stover.
Per 2,000 pounds, . .	$28 00	$25 00	$28 00	$26 00	$28 00	$15 00	$3 50	$5 00
Per pound (cents), . .	1.4	1.25	1.4	1.3	1.4	0.75	0.175	0.25

Commercial Value of the Essential Fertilizing Constitutents of the Above Fodder Articles.

Nitrogen, 15 cents; phosphoric acid, 5½ cents; potassium oxide, 4½ cents per pound.

Moisture, ...	13.26	12.11	9.77	8.72	10.90	13.90	71.03	19.89
Nitrogen, ...	1.796	2.599	6.412	5.285	4.959	1.853	.708	.735
Phosphoric acid, . . .	.707	2.845	2.333	1.780	.425	.464	.420	.259
Potassium oxide, . . .	.435	1.625	1.723	1.214	.045	1.966	.444	1.235
Valuation per 2,000 pounds,	$6 56	$12 39	$23 36	$18 90	$15 38	$7 84	$2 98	$3 60

Obtainable Manurial Value (per Ton), allowing a Loss of 20 Per Cent. contained in the Milk sold.

	$5 25	$9 91	$18 69	$15 12	$12 30	$6 27	$2 38	$2 88

Net Cost of Above Fodder Articles per 2,000 Pounds (obtained by deducting the Obtainable 80 Per Cent. of Manurial Value from their Market Cost).

	$22 75	$15 09	$9 31	$10 88	$15 70	$8 73	$1 12	$2 12

Net Cost per Pound (Cents).

	1.14	0.75	0.465	0.54	0.78	0.44	0.056	0.106

Average Composition of the Principal Daily Fodder Rations used at Different Periods of the Experiment.

I.		II.	
Corn meal (pounds), .	3.00	Corn meal (pounds), .	3.00
Wheat bran, ...	3.00	Wheat bran, ...	3.00
Cotton-seed meal, . .	3.00	Gluten meal, ...	3.00
Rowen, ...	20.00	Rowen, ...	17.50
Total cost (cents), . .	27.15	Total cost (cents), . .	25.28
Net cost, ...	15.81	Net cost, ...	15.68
Manurial value obtainable,	11.34	Manurial value obtainable,	9.60
Nutritive ratio, . . .	1 : 4.60	Nutritive ratio, . . .	1 : 5.13

Average Composition, etc. — Concluded.

III.	
Corn meal (pounds),	3.00
Wheat bran,	3.00
Old-process linseed meal,	3.00
Rowen,	17.40
Total cost (cents),	24.90
Net cost,	14.91
Manurial value obtainable,	9.99
Nutritive ratio,	1 : 4.83

IV.	
Corn meal (pounds),	3.00
Wheat bran,	3.00
Cotton-seed meal,	3.00
Rowen,	5.00
Corn and soja bean ensilage,	42.15
Total cost (cents),	23.28
Net cost,	11.62
Manurial value obtainable,	11.66
Nutritive ratio,	1 : 4.17

V.	
Corn meal (pounds),	3.00
Wheat bran,	3.00
Gluten meal,	3.00
Rowen,	5.00
Corn and soja bean ensilage,	46.15
Total cost (cents),	23.98
Net cost,	12.80
Manurial value obtainable,	11.18
Nutritive ratio,	1 : 4.70

VI.	
Corn meal (pounds),	3.00
Wheat bran,	3.00
Gluten meal,	3.00
Corn stover,	13.90
Total cost (cents),	15.63
Net cost,	9.52
Manurial value obtainable,	6.11
Nutritive ratio,	1 : 6.74

VII.	
Corn meal (pounds),	3.00
Wheat bran,	3.00
Cotton-seed meal,	3.00
Corn stover,	14.00
Total cost (cents),	15.65
Net cost,	8.57
Manurial value obtainable,	7.08
Nutritive ratio,	1 : 5.66

VIII.	
Corn meal (pounds),	3.00
Wheat bran,	3.00
Cotton-seed meal,	3.00
Rowen,	17.60
Total cost (cents),	25.35
Net cost,	14.77
Manurial value obtainable,	10.58
Nutritive ratio,	1 : 4.49

IX.	
Corn meal (pounds),	3.00
Wheat bran,	3.00
Gluten meal,	3.00
Rowen,	17.40
Total cost (cents),	25.20
Net cost,	15.63
Manurial value obtainable,	9.57
Nutritive ratio,	1 : 5.12

Summary of the Cost of the Daily Fodder Rations (Cents).

	PERIODS.								
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
Market cost, .	27.15	25.28	24.90	23.28	23.98	15.63	15.65	25.35	25.20
Manurial value obtainable, .	11.34	9.60	9.99	11.66	11.18	6.11	7.08	10.58	9.57
Net cost, . .	15.81	15.68	14.91	11.62	12.80	9.52	8.57	14.77	15.63

4. *On Valuation of Feed.*

The commercial valuation of the feed adopted in this report is based on the contemporary local market cost (November, 1890, to May, 1891) of the different fodder articles used, *i. e.*, their retail selling price at Amherst per ton. The market price of the coarse fodder constituents of the daily diet, as rowen, fodder corn, corn ensilage, soja beans and corn stover, is the same as during the preceding year for the same period, November, 1889, to May, 1890, while that of most of the grain feed constituents of the daily diet, as corn meal, wheat bran, gluten meal and cotton-seed meal, is exceptionally high as compared with that during the preceding year for corresponding months. Old-process linseed meal alone had suffered a slight reduction, one dollar per ton.

The changes in their market price were as follows: —

Local Market Price per Ton of 2,000 Pounds at Amherst, Mass.

	November, 1889, to June, 1890.	November, 1890, to June, 1891.
Corn meal, ...	$19 00	$28 00
Wheat bran, ...	17 50	25 00
Cotton-seed meal, ...	26 00	28 00
Old-process linseed meal, ...	27 00	26 00
Gluten meal (Chicago), ...	24 50	28 00
Rowen, ...	15 00	15 00
Corn and soja bean ensilage, ...	3 50	3 50
Corn stover, ...	5 00	5 00

The above-stated change in the market cost of corn meal, wheat bran, gluten meal and cotton-seed meal affects very materially the cost of the daily diet as compared with that of the preceding year. The daily *grain feed rations* which contain gluten meal as an ingredient (II., V., VI., IX.) are 3.32 cents higher than they would have been during the preceding year for the corresponding months; those which contain cotton-seed meal (I., IV., VII., VIII.) are 2.85 cents higher, and that which contains old-process linseed meal (III.) is 2.40 cents higher. This increase in cost is largely due to the exceptional high price of corn meal and wheat bran.

The substitution of gluten meal or of cotton-seed meal by old-process linseed meal, three pounds in each case, causes a reduction of but 0.3 cents in the market cost of the grain feed portion of the daily diet per head. *The market cost of the daily grain feed rations used per head during the entire experiment varies only from 11.85 cents to 12.15 cents, a difference of 0.3 cents.* Allowing, however, a proper recognition of the commercial value of the essential manurial substances, nitrogen, phosphoric acid and potassium oxide, contained in each of the grain feed constituents of the daily fodder rations, *we find in our case that the net cost of the cotton-seed meal containing daily grain feed rations (I.) amounts to 7.07 cents, while that of the old-process linseed meal containing daily grain feed rations (II.) is 7.29 cents, and that of gluten meal containing fine feed rations (III.) is 8.01 cents, a difference respectively of 0.22 to 0.94 cents per head.* This difference in net cost is due to the higher manurial value of cotton-seed meal and of old-process linseed meal as compared with gluten meal at stated market prices.

The choice of different coarse fodder articles in the daily diet exerts a much greater influence on the market cost of the latter than that of the different kinds of grain feed. The market cost of the coarse fodder portion of the daily diet averages 13.5 cents in case rowen alone (eighteen pounds) serves as coarse feed; it averages 11.5 cents in case forty-four pounds of mixed ensilage and five pounds of rowen are daily fed; and it amounts to from 4 to 4½ cents in case from sixteen to eighteen pounds of corn stover are used per day for that purpose. These facts find their expression in the above-stated market cost of the nine complete daily fodder rations used during the trial. The market cost of the complete daily fodder rations I., II., III., VIII., IX., containing rowen, averages 25.55 cents; rations IV., V., containing mixed ensilage with rowen, average 23.63 cents; and rations VI., VII., containing corn stover as coarse feed, average 15.64 cents. *The difference in the market cost of the above-described nine daily fodder rations, caused by the use of different coarse fodder constituents, rises in some instances as high as 9.91 cents.* This sum, it will be noticed, is three times as large as the difference due to an exceptional rise in the market cost of the grain feed portion of the various daily fodder rations used, accepting the ruling local market prices of feed stuff at the close of 1889 and of 1890 as the basis of our valuation.

Taking the manurial value of the different coarse fodder constituents used into consideration, we find the difference of their *net cost* not less striking than has been shown above to be the case in regard to their *market cost.*

	Market Cost.	Net Cost.	Manurial Value.
	Cents.	Cents.	Cents.
Rowen, 18 pounds, ...	13.5	7.92	5.57
Mixed ensilage, 44 pounds, rowen, 5 pounds, ...	11.45	4.66	6.79
Corn stover, 18 pounds, . . .	4.50	1.91	2.59

The high market price of two of our most prominent home-raised coarse fodder articles, first and second cut of upland meadow, — English hay and rowen, — affects seriously the degree of our financial results in the production of milk, as far as the cost of feed is concerned. We are in need of a cheaper source of supply of coarse fodder substances than a considerable proportion of our grass lands, pastures and meadows in their present state of productiveness can claim to give. More satisfactory results can be obtained, no doubt, in many cases by turning indifferently yielding dry grass lands, if at all capable of higher cultivation, to account for the production of some other suitable fodder crop than grasses. The good services of dry fodder corn, corn stover and a good corn ensilage, for a more economical production of milk, are deservedly from day to day more generally recognized. However gratifying this fact may be considered, it is not advisable, in the light of past experience, in a general farm management to raise one fodder crop at the exclusion of all others, however lucrative at the time this practice may prove; such a course can at best only offer a temporary relief. The introduction of a greater variety, in particular, of annual reputed fodder-crops promises a more permanent improvement in fodder supply. Such a course, wherever adopted, has not only resulted in cheapening the production of milk and beef, but has proved to be a most economical way to raise the general productiveness of farm lands to a higher standard.

Our local experience with a variety of annual leguminous fodder crops, as vetches, serradella and soja bean, has been very encouraging. The satisfactory results obtained in previous years are fully confirmed during the present season, when a mixed crop of vetch and oats and soja bean has served as the principal coarse fodder for milk production from the middle of June to the beginning of September.

5. *Average Quantity of Milk per Day (Quarts).*

	FEEDING PERIODS.								
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
1. Jessie, . . .	6.77	5.30	5.70	7.54	8.47	6.80	5.50	–	–
2. Pearl, . . .	10.74	10.28	10.84	–	12.19	9.07	7.34	9.19	9.24
3. Pink, . . .	7.55	7.42	–	8.07	8.30	7.05	6.56	7.48	7.63
4. Roxy, . . .	6.87	5.64	5.25	–	–	–	–	–	–
5. Buttercup, . .	–	–	–	13.36	13.31	10.66	9.31	9.45	8.68
6. Nancy, . . .	8.34	7.68	7.49	8.31	8.54	–	–	–	–
7. Clarissa, . . .	–	–	–	–	–	–	9.47	10.04	11.37
8. Juno, . . .	7.29	6.70	6.45	7.50	–	–	–	–	–
9. Favorite, . . .	–	–	–	–	–	11.33	7.89	10.05	9.60

An examination of the above statements concerning the daily average yield of milk of the different cows on trial during the different feeding periods shows, almost without exception, that *our changes in the coarse fodder constituents of the daily diet have affected the results more seriously than our changes in the grain feed portion.* Among the coarse feed constituents used, ranks first mixed ensilage and rowen (periods IV., V.), then rowen (I., II., III., VIII., IX.) and dry corn stover last (VI., VII.), as far as the daily yield of milk is concerned.

The difference noticeable in the daily average yield of milk in case of rowen, as compared with corn stover, does in no instance deprive the latter of the claim to be the cheaper coarse fodder article of the two in our trial. Mixed ensilage, with rowen in place of corn stover, on the other hand, has raised in some instances the daily yield of milk more than three quarts (Pearl and Buttercup); allowing three cents per quart of milk makes the former the cheaper coarse fodder article of the two, under otherwise corresponding circumstances. These results are noticeable without reference to the particular combination of grain feed rations used in either case.

The influence of the various grain feed rations on the yield of milk in case of the same kind of coarse fodder ration is apparently, to a considerable degree, depending on the individual disposition of the animal on trial. Cotton-seed meal containing grain feed rations give in five out of six cases better results when fed with rowen than either gluten meal or old-process linseed meal ration, under otherwise corresponding conditions. Gluten meal and cotton-seed meal did equally well when fed with either mixed ensilage or corn stover. Old-process linseed meal has only been fed with rowen on the present occasion (I., II., III.); it compared well in yield of milk with gluten meal.

I. — Variations in daily production of milk during the entire feeding experiment (quarts).

II. — Average quantity of milk per day for the entire feeding experiment (quarts).

	I.	II.
Jessie,	5.30 — 8.48	6.58
Pearl,	7.34 — 12.19	9.86
Pink,	6.56 — 8.30	7.51
Roxy,	5.23 — 6.81	5.89
Buttercup,	8.69 — 13.36	10.80
Nancy,	7.49 — 8.54	8.07
Clarissa,	9.47 — 11.37	10.29
Juno,	6.45 — 7.50	6.99
Favorite,	7.89 — 11.33	9.72

Average Composition of Milk during Different Feeding Periods.

		1	2	3	4	5	6	7	8	9
PERIODS.		Jessie.	Pearl.	Pink.	Roxy.	Buttercup.	Nancy.	Clarissa.	Juno.	Favorite.
I.,	Solids, per cent.,	15.62	12.62	15.37	14.79	-	13.13	-	13.91	-
	Fat, per cent.,	6.17	3.92	5.70	5.19	-	4.41	-	4.71	-
II.,	Solids, per cent.,	17.85	12.77	14.73	15.18	-	13.33	-	13.82	-
	Fat, per cent.,	7.39	4.00	5.13	5.12	-	4.31	-	4.36	-
III.,	Solids, per cent.,	17.69	13.50	-	15.31	-	14.47	-	14.30	-
	Fat, per cent.,	7.07	4.06	-	5.00	-	4.80	-	4.88	-
IV.,	Solids, per cent.,	17.61	-	15.90	-	12.64	14.68	-	14.34	-
	Fat, per cent.,	7.09	-	6.00	-	3.65	5.00	-	4.96	-
V.,	Solids, per cent.,	17.36	13.69	15.53	-	12.81	14.75	-	-	-
	Fat, per cent.,	7.02	4.27	5.74	-	3.79	5.00	-	-	-
VI.,	Solids, per cent.,	17.02	13.94	15.86	-	12.64	-	-	-	13.09
	Fat, per cent.,	6.47	4.48	5.67	-	3.96	-	-	-	4.35
VII.,	Solids, per cent.,	17.63	14.32	16.56	-	12.50	-	14.18	-	13.53
	Fat, per cent.,	7.26	5.04	6.09	-	4.05	-	5.01	-	4.58
VIII.,	Solids, per cent.,	-	13.74	15.82	-	12.98	-	14.18	-	12.78
	Fat, per cent.,	-	4.84	5.65	-	4.18	-	5.08	-	4.19
IX.,	Solids, per cent.,	-	13.66	15.54	-	13.45	-	13.79	-	12.40
	Fat, per cent.,	-	4.04	5.43	-	4.27	-	4.60	-	3.48

Live Weight of Animals during the Feeding Periods (Pounds).

NAME.	FEEDING PERIODS.									Gain at Close.
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	
Jessie,	926	920	965	976	988	951	938	-	-	12
Pearl,	850	877	869	-	872	853	858	853	880	30
Pink,	910	932	-	914	948	947	952	956	973	63
Roxy,	1,010	1,016	992	-	-	-	-	-	-	—18
Buttercup,	-	-	-	781	797	795	785	766	775	—6
Nancy,	946	942	948	963	987	-	-	-	-	41
Clarissa,	-	-	-	-	-	-	833	856	848	15
Juno,	1,142	1,124	1,135	1,114	-	-	-	-	-	—28
Favorite,	-	-	-	-	-	826	775	809	801	—25

Conclusions. — A careful examination of the previously recorded results of our inquiry into the respective particular claims of cotton-seed meal, old-process linseed meal and gluten meal as constituents of the daily diet of milch cows, leads us to the following statements: —

1. The substitution of three pounds of gluten meal by either three pounds of cotton-seed meal or three pounds of old-process linseed meal, at stated market prices, and under otherwise corresponding circumstances, does not materially effect the *market cost* of the daily fodder ration used in our case. The difference in their market price amounts to 0.3 cents in favor of old-process linseed meal. Taking the obtainable manurial value into consideration, as far as the three stated grain feed constituents of the daily diet are concerned, three pounds of cotton-seed meal are 0.94 cents cheaper than three pounds of gluten meal and 0.22 cents cheaper than three pounds of old-process linseed meal.

2. The comparative nutritive effect of cotton-seed meal, gluten meal and old-process linseed meal, as far as their influence on the yield of milk is concerned, in case of otherwise corresponding fodder rations, depends evidently in a controlling degree on two distinctly different circumstances, namely, the individual disposition and constitution of the animal on trial, and on the particular kind of coarse fodder constituent of the daily diet. In case of rowen as coarse fodder constituent, cotton-seed meal leads, in five out of six cases, both gluten meal and old-process linseed meal, while in case mixed ensilage or corn stover served as coarse feed the gluten meal competes well with cotton-seed meal. Old-process linseed meal has only been tested with rowen on the present occasion; it stands but little behind the gluten meal.

3. The density of the milk in case of the same cow varies but little during the experiment; the notable changes are apparently, in a controlling degree, due to the particular condition and individuality of the cow engaged in the trial.

FEEDING RECORD.

1. *Jessie.*

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.								Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
	Corn Meal.	Wheat Bran.	Cotton-seed Meal.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn and Soja Bean Ensilage.	Corn Stover.					
1890-91.													
Nov. 1 to Nov. 21, . .	3.00	3.00	3.00	–	–	17.81	–	–	23.28	6.77	3.44	1:4.51	926
Nov. 26 to Dec. 16, . .	3.00	3.00	–	–	3.00	16.23	–	–	21.88	5.30	4.13	1:5.09	920
Dec. 22 to Jan. 11, . .	3.00	3.00	–	3.00	–	17.91	–	–	23.40	5.70	4.11	1:4.85	965
Jan. 26 to Feb. 11, . .	3.00	3.00	3.00	–	–	5.00	43.94	–	24.99	7.54	3.31	1:4.19	976
Feb. 14 to March 4, . .	3.00	3.00	–	–	3.00	5.00	47.11	–	25.87	8.48	3.05	1:4.71	988
March 10 to March 25, . .	3.00	3.00	–	–	3.00	–	–	11.16	16.85	6.80	2.48	1:6.33	951
March 28 to April 12, . .	3.00	3.00	3.00	–	–	–	–	13.59	18.84	5.50	3.43	1:5.61	938

2. *Pearl.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Cotton-seed Meal.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn and Soja Bean Ensilage.	Corn Stover.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
Nov. 1 to Nov. 21, . .	3.00	3.00	3.00	–	–	21.19	–	–	26.19	10.74	2.44	1:4.65	850
Nov. 26 to Dec. 16, . .	3.00	3.00	–	–	3.00	17.81	–	–	23.24	10.28	2.26	1:5.14	877
Dec. 22 to Jan. 11, . .	3.00	3.00	–	3.00	–	18.26	–	–	23.70	10.84	2.19	1:4.86	869
Feb. 14 to March 4, . .	3.00	3.00	–	–	3.00	5.00	48.05	–	26.14	12.19	2.14	1:4.71	872
March 10 to March 25, . .	3.00	3.00	–	–	3.00	–	–	16.06	20.78	9.07	2.29	1:7.06	853
March 28 to April 12, . .	3.00	3.00	3.00	–	–	–	–	14.50	19.57	7.34	2.67	1:5.74	858
April 16 to May 6, . .	3.00	3.00	3.00	–	–	19.40	–	–	24.65	9.19	2.68	1:4.57	853
May 11 to May 31, . .	3.00	3.00	–	–	3.00	18.33	–	–	23.69	9.24	2.56	1:5.16	880

FEEDING RECORD — *Continued.*

3. *Pink.*

FEEDING PERIODS.	Feed consumed (Pounds) per Day.								Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
	Corn Meal.	Wheat Bran.	Cotton-seed Meal.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn and Soja Bean Ensilage.	Corn Stover.					
1890-91.													
Nov. 1 to Nov. 21, . .	3.00	3.00	3.00	–	–	21.83	–	–	26.75	7.55	3.54	1:4.67	910
Nov. 26 to Dec. 16, . .	3.00	3.00	–	–	3.00	20.81	–	–	25.93	7.42	3.49	1:5.23	932
Jan. 26 to Feb. 11, . .	3.00	3.00	3.00	–	–	5.00	46.59	–	25.75	8.07	3.19	1:4.20	914
Feb. 14 to March 4, . .	3.00	3.00	–	–	3.00	5.00	48.79	–	26.35	8.30	3.17	1:4.71	948
March 10 to March 25, . .	3.00	3.00	–	–	3.00	–	–	15.75	20.53	7.05	2.91	1:7.01	947
March 28 to April 12, . .	3.00	3.00	3.00	–	–	–	–	17.50	21.97	6.56	3.35	1:6.15	952
April 16 to May 6, . .	3.00	3.00	3.00	–	–	19.57	–	–	24.80	7.48	3.32	1:4.58	946
May 11 to May 31, . .	3.00	3.00	–	–	3.00	19.38	–	–	24.60	7.63	3.22	1:5.19	973

4. *Roxy.*

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Cotton-seed Meal.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn and Soja Bean Ensilage.	Corn Stover.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
Nov. 1 to Nov. 21, . .	3.00	3.00	3.00	–	–	19.14	–	–	24.43	6.81	3.59	1:4.56	1,010
Nov. 26 to Dec. 16, . .	3.00	3.00	–	–	3.00	15.74	–	–	21.46	5.64	3.80	1:5.07	1,016
Dec. 22 to Jan. 11, . .	3.00	3.00	–	3.00	–	15.24	–	–	21.10	5.23	4.04	1:4.74	992

5. *Buttercup.*

Jan. 29 to Feb. 11, . .	3.00	3.00	3.00	–	–	5.00	42.61	–	24.60	13.36	1.84	1:4.18	781
Feb. 14 to March 4, . .	3.00	3.00	–	–	3.00	5.00	44.26	–	25.04	13.31	1.88	1:4.70	797
March 10 to March 25, . .	3.00	3.00	–	–	3.00	–	–	15.41	20.25	10.66	1.90	1:6.96	795
March 28 to April 12, . .	3.00	3.00	3.00	–	–	–	–	16.34	21.04	9.31	2.26	1:6.00	785
April 16 to May 6, . .	3.00	3.00	3.00	–	–	15.98	–	–	21.71	9.45	2.30	1:4.42	766
May 11 to May 31, . .	3.00	3.00	–	–	3.00	15.57	–	–	31.32	8.69	2.45	1:5.07	775

6. *Nancy.*

Nov. 1 to Nov. 21, . .	3.00	3.00	3.00	–	–	20.83	–	–	25.88	8.34	3.10	1:4.63	946
Nov. 26 to Dec. 16, . .	3.00	3.00	–	–	3.00	18.45	–	–	23.80	7.68	3.10	1:5.16	942
Dec. 22 to Jan. 11, . .	3.00	3.00	–	3.00	–	18.19	–	–	23.64	7.49	3.16	1:4.86	948
Jan. 26 to Feb. 11, . .	3.00	3.00	3.00	–	–	5.00	41.41	–	24.26	8.31	2.92	1:4.17	963
Feb. 14 to March 4, . .	3.00	3.00	–	–	3.00	5.00	42.63	–	24.57	8.54	2.88	1:4.69	987

7. *Clarissa.*

March 28 to April 12, . .	3.00	3.00	3.00	–	–	–	–	14.31	19.41	9.47	2.05	1:5.72	833
April 16 to May 6, . .	3.00	3.00	3.00	–	–	18.48	–	–	23.86	10.04	2.38	1:4.54	856
May 11 to May 31, . .	3.00	3.00	–	–	3.00	19.43	–	–	24.64	11.37	2.17	1:5.19	848

FEEDING RECORD — *Concluded.*

8. Juno.

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.								Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
	Corn Meal.	Wheat Bran.	Cotton-seed Meal.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn and Soja Bean Ensilage.	Corn Stover.					
1890-91.													
Nov. 1 to Nov. 21, . .	3.00	3.00	3.00	–	–	19.50	–	–	24.74	7.29	3.39	1: 4.58	1,142
Nov. 26 to Dec. 16, . .	3.00	3.00	–	–	3.00	16.02	–	–	21.70	6.70	3.24	1: 5.08	1,124
Dec. 22 to Jan. 11, . .	3.00	3.00	–	3.00	–	17.29	–	–	22.87	6.45	3.55	1: 4.82	1,135
Jan. 26 to Feb. 11, . .	3.00	3.00	3.00	–	–	5.00	36.23	–	22.76	7.50	3.03	1: 4.13	1,114

9. Favorite.

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Cotton-seed Meal.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn and Soja Bean Ensilage.	Corn Stover.	Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Period (Pounds).
March 10 to March 25, . .	3.00	3.00	–	–	3.00	–	–	11.16	16.85	11.33	1.49	1: 6.33	826
March 28 to April 12, . .	3.00	3.00	3.00	–	–	–	–	8.22	14.54	7.89	1.84	1: 4.76	775
April 16 to May 6, . .	3.00	3.00	3.00	–	–	14.48	–	–	20.42	10.05	2.03	1: 4.34	809
May 11 to May 31, . .	3.00	3.00	–	–	3.00	14.19	–	–	20.13	9.60	2.10	1: 5.01	801

TOTAL COST OF FEED PER QUART OF MILK.

1. *Jessie.*

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Cotton-seed Meal consumed (Pounds).	Total Amount of Old-process Linseed Meal consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Corn and Soja Bean Ensilage consumed (Pounds).	Total Amount of Corn Stover consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
1890 91.												
Nov. 1 to Nov. 21, . .	142.21	6.77	63.00	63.00	63.00	–	–	374.00	–	–	$5 36	3.77
Nov. 26 to Dec. 16, . .	111.40	5.30	63.00	63.00	–	–	63.00	313.00	–	–	5 12	4.60
Dec 22 to Jan. 11, . .	119.77	5.70	63.00	63.00	–	63.00	–	376.00	–	–	5 31	4.43
Jan. 26 to Feb. 11, . .	128.26	7.54	51.00	51.00	51.00	–	–	85.00	747.00	–	4 01	3.13
Feb. 14 to March 4, . .	161.02	8.48	57.00	57.00	–	–	57.00	95.00	895.00	–	4 69	2.91
March 10 to March 25, . .	108.72	6.80	48.00	48.00	–	–	48.00	–	–	178.50	2 39	2.20
March 28 to April 12, . .	88.02	5.50	48.00	48.00	48.00	–	–	–	–	217.50	2 48	2.82

2. *Pearl.*

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Cotton-seed Meal consumed (Pounds).	Total Amount of Old-process Linseed Meal consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Corn and Soja Bean Ensilage consumed (Pounds).	Total Amount of Corn Stover consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
Nov. 1 to Nov. 21, . .	225.58	10.74	63.00	63.00	63.00	–	–	445.00	–	–	$5 89	2.61
Nov. 26 to Dec. 16, . .	215.81	10.28	63.00	63.00	–	–	63.00	374.00	–	–	5 36	2.48
Dec. 22 to Jan. 11, . .	227.56	10.84	63.00	63.00	–	63.00	–	383.50	–	–	5 37	2.37
Feb. 14 to March 4, . .	231.74	12.19	57.00	57.00	–	–	57.00	95.00	913.00	–	4 62	1.99
March 10 to March 25, . .	145.12	9.07	48.00	48.00	–	–	48.00	–	–	257.00	2 58	1.78
March 28 to April 12, . .	117.44	7.34	48.00	48.00	48.00	–	–	–	–	232.00	2 52	2.15
April 16 to May 6, . .	193.05	9.19	63.00	63.00	63.00	–	–	407.50	–	–	5 61	2.91
May 11 to May 31, . .	194.07	9.24	63.00	63.00	–	–	63.00	385.00	–	–	5 44	2.80

TOTAL COST OF FEED PER QUART OF MILK — *Continued.*

3. *Pink.*

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Cotton-seed Meal consumed (Pounds).	Total Amount of Old-process Linseed Meal consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Corn and Soja Bean Ensilage consumed (Pounds).	Total Amount of Corn Stover consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
1890-91.												
Nov. 1 to Nov. 21, . .	158.49	7.55	63.00	63.00	63.00	-	-	458.50	-	-	$5 99	3.78
Nov. 26 to Dec. 16, . .	155.81	7.42	63.00	63.00	-	-	63.00	437.00	-	-	5 83	3.74
Jan. 26 to Feb. 11, . .	137.21	8.07	51.00	51.00	51.00	-	-	85.00	792.00	-	4 09	2.98
Feb. 14 to March 4, . .	155.79	8.30	57.00	57.00	-	-	57.00	95.00	990.00	-	4 75	3.05
March 10 to March 25, . .	112.79	7.05	48.00	48.00	-	-	48.00	-	-	252.00	2 57	2.28
March 28 to April 12, . .	105.00	6.56	48.00	48.00	48.00	-	-	-	-	280.00	2 64	2.51
April 16 to May 6, . .	157.09	7.48	63.00	63.00	63.00	-	-	411.00	-	-	5 63	3.58
May 11 to May 31, . .	160.23	7.63	63.00	63.00	-	-	63.00	407.00	-	-	5 60	3.49

4. *Roxy.*

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Cotton-seed Meal consumed (Pounds).	Total Amount of Old-process Linseed Meal consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Corn and Soja Bean Ensilage consumed (Pounds).	Total Amount of Corn Stover consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
Nov. 1 to Nov. 21, . .	143.02	6.81	63.00	63.00	63.00	-	-	402.00	-	-	$5 57	3.89
Nov. 26 to Dec. 16, . .	118.49	5.64	63.00	63.00	-	-	63.00	330.50	-	-	5 03	4.25
Dec. 22 to Jan. 11, . .	109.77	5.23	63.00	63.00	-	63.00	-	320.00	-	-	4 89	4.45

5. *Buttercup.*

Jan. 29 to Feb. 11, . .	186.98	13.36	42.00	42.00	42.00	–	–	70.00	596.50	–	$3 27	1.75
Feb. 14 to March 4, . .	252.80	13.31	57.00	57.00	–	–	57.00	95.00	841.00	–	4 49	1.78
March 10 to March 25, . .	170.58	10.66	48.00	48.00	–	–	48.00	–	–	246.50	2 56	1.50
March 28 to April 12, . .	148.95	9.31	48.00	48.00	48.00	–	–	–	–	261.50	2 59	1.74
April 16 to May 6, . .	198.49	9.45	63.00	63.00	63.00	–	–	335.50	–	–	5 07	2.55
May 11 to May 31, . .	182.56	8.69	63.00	63.00	–	–	63.00	327.00	–	–	5 00	2.74

6. *Nancy.*

Nov. 1 to Nov. 21, . .	175.23	8.34	63.00	63.00	63.00	–	–	437.50	–	–	$5 83	3.33
Nov. 26 to Dec. 16, . .	161.28	7.68	63.00	63.00	–	–	63.00	387.50	–	–	5 46	3.39
Dec. 22 to Jan 11, . .	157.21	7.49	63.00	63.00	–	63.00	–	382.00	–	–	5 35	3.40
Jan. 26 to Feb. 11, . .	141.28	8.31	51.00	51.00	51.00	–	–	85.00	704.00	–	3 93	2.78
Feb. 14 to March 4, . .	162.33	8.54	57.00	57.00	–	–	57.00	95.00	810.00	–	4 44	2.73

7. *Clarissa.*

March 28 to April 12, . .	151.51	9.47	48.00	48.00	48.00	–	–	–	–	229.00	$2 51	1.66
April 16 to May 6, . .	210.81	10.04	63.00	63.00	63.00	–	–	388.00	–	–	5 46	2.59
May 11 to May 31, . .	238.72	11.37	63.00	63.00	–	–	63.00	408.00	–	–	5 61	2.35

TOTAL COST OF FEED PER QUART OF MILK — *Concluded.*

8. Juno.

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Cotton-seed Meal consumed (Pounds).	Total Amount of Old-process Linseed Meal consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Corn and Soja Bean Ensilage consumed (Pounds).	Total Amount of Corn Stover consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
1890-91.												
Nov. 1 to Nov. 21, . .	153.14	7.29	63.00	63.00	63.00	–	–	409.50	–	–	$5 62	3.67
Nov. 26 to Dec. 16, . .	140.70	6.70	63.00	63.00	–	–	63.00	336.50	–	–	5 07	3.60
Dec. 22 to Jan. 11, . .	135.35	6.45	63.00	63.00	–	63.00	–	363.00	–	–	5 21	3.85
Jan. 26 to Feb. 11, . .	127.56	7.50	51.00	51.00	51.00	–	–	85.00	616.00	–	3 78	2.96

9. Favorite.

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Cotton-seed Meal consumed (Pounds).	Total Amount of Old-process Linseed Meal consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Corn and Soja Bean Ensilage consumed (Pounds).	Total Amount of Corn Stover consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
March 10 to March 25, . .	181.28	11.33	48.00	48.00	–	–	48.00	–	–	178.50	$2 39	1.32
March 28 to April 12, . .	126.30	7.89	48.00	48.00	48.00	–	–	–	–	131.50	2 27	1.80
April 16 to May 6, . .	211.05	10.05	63.00	63.00	63.00	–	–	304.00	–	–	4 83	2.29
May 11 to May 31, . .	201.51	9.60	63.00	63.00	–	–	63.00	298.00	–	–	4 79	2.38

NET COST OF MILK AND MANURIAL VALUE OF FEED CONSUMED.

1. *Jessie.*

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1890-91.					Cents.	Pounds.
Nov. 1 to Nov. 21, .	$5 36	$2 81	$2 25	$3 11	2.19	920
Nov. 26 to Dec. 16, .	5 12	2 42	1 94	3 18	2.85	947
Dec. 22 to Jan. 11, .	5 31	2 67	2 14	3 17	2.65	998
Jan. 26 to Feb. 11, .	4 01	2 53	2 02	1 99	1.55	973
Feb. 14 to Mar. 4, .	4 69	2 68	2 14	2 55	1.58	995
Mar. 10 to Mar. 25, .	2 39	1 15	0 92	1 47	1.35	940
Mar. 28 to Apr. 12, .	2 48	1 41	1 13	1 35	1.53	932
Total, . .	$29 36	$15 67	$12 54	$16 82	-	-

2. *Pearl.*

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
Nov. 1 to Nov. 21, .	$5 89	$3 08	$2 46	$3 43	1.52	864
Nov. 26 to Dec. 16, .	5 36	2 55	2 04	3 32	1.54	876
Dec. 22 to Jan. 11, .	5 37	2 70	2 16	3 21	1.41	876
Feb. 14 to Mar. 4, .	4 62	2 71	2 17	2 45	1.06	873
Mar. 10 to Mar 25, .	2 58	1 29	1 03	1 55	1.07	850
Mar. 28 to Apr. 12, .	2 52	1 44	1 15	1 37	1.17	865
Apr. 16 to May 6, .	5 61	2 94	2 35	3 26	1.69	842
May 11 to May 31, .	5 44	2 59	2 07	3 37	1.74	874
Total, . .	$37 39	$19 30	$15 43	$21 96	-	-

3. *Pink.*

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
Nov. 1 to Nov. 21, .	$5 99	$3 14	$2 51	$3 48	2.20	910
Nov. 26 to Dec. 16, .	5 83	2 80	2 24	3 59	2.30	950
Jan 26 to Feb. 11, .	4 09	2 60	2 08	2 01	1.47	922
Feb. 14 to Mar. 4, .	4 75	2 83	2 26	2 49	1.60	953
Mar. 10 to Mar. 25, .	2 57	1 28	1 02	1 55	1.37	940
Mar. 28 to Apr. 12, .	2 64	1 52	1 22	1 42	1.35	970
Apr. 16 to May 6, .	5 63	2 95	2 36	3 27	2.08	940
May 11 to May 31, .	5 60	2 68	2 14	3 46	2.16	973
Total, . .	$37 10	$19 80	$15 83	$21 27	-	-

NET COST OF MILK AND MANURIAL VALUE OF FEED — *Continued.*

4. *Roxy.*

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1890-91.					Cents.	Pounds.
Nov. 1 to Nov. 21, .	$5 57	$2 92	$2 34	$3 23	2.26	1,008
Nov. 26 to Dec. 16, .	5 03	2 38	1 90	3 13	2.64	1,034
Dec. 22 to Jan. 11, .	4 89	2 45	1 96	2 93	2.67	1,010
Total, . .	$15 49	$7 75	$6 20	$9 29	-	-

5. *Buttercup.*

Jan. 29 to Feb. 11, .	$3 27	$2 05	$1 64	$1 63	0.87	800
Feb. 14 to Mar. 4, .	4 49	2 60	2 08	2 41	1.29	797
Mar. 10 to Mar. 25, .	2 56	1 27	1 01	1 55	0.91	800
Mar. 28 to Apr. 12, .	2 59	1 49	1 19	1 40	0.94	795
Apr. 16 to May 6, .	5 07	2 66	2 13	2 94	1.48	753
May 11 to May 31, .	5 00	2 36	1 89	3 11	1.70	775
Total, . .	$22 98	$12 43	$9 94	$13 04	-	-

6. *Nancy.*

Nov. 1 to Nov. 21, .	$5 83	$3 06	$2 45	$3 38	1.93	925
Nov. 26 to Dec. 16, .	5 46	2 60	2 08	3 38	2.10	960
Dec. 22 to Jan. 11, .	5 35	2 70	2 16	3 19	2.03	972
Jan. 26 to Feb. 11, .	3 93	2 47	1 97	1 96	1.39	963
Feb. 14 to Mar. 4, .	4 44	2 56	2 05	2 39	1.47	985
Total, . .	$25 01	$13 39	$10 71	$14 30	-	-

7. *Clarissa.*

Mar. 28 to Apr. 12, .	$2 51	$1 43	$1 14	$1 37	0.90	843
Apr. 16 to May 6, .	5 46	2 86	2 29	3 17	1.50	835
May 11 to May 31, .	5 61	2 68	2 14	3 47	1.45	855
Total, . .	$13 58	$6 97	$5 57	$8 01	-	-

NET COST OF MILK AND MANURIAL VALUE OF FEED — *Concluded.*

8. Juno.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1890-91.					Cents.	Pounds.
Nov. 1 to Nov. 21, .	$5 62	$2 95	$2 36	$3 26	2.13	1,130
Nov. 26 to Dec. 16, .	5 07	2 40	1 92	3 15	2.24	1,143
Dec. 22 to Jan. 11, .	5 21	2 62	2 10	3 11	2.30	1,150
Jan 26 to Feb. 11, .	3 78	2 34	1 87	1 91	1.50	1,105
Total, . .	$19 68	$10 31	$8 25	$11 43	–	–

9. Favorite.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
Mar. 10 to Mar. 25, .	$2 39	$1 15	$0 92	$1 47	0.81	790
Mar. 28 to Apr. 12, .	2 27	1 26	1 01	1 26	0.99	785
Apr. 16 to May 6, .	4 83	2 53	2 02	2 81	1.33	782
May 11 to May 31, .	4 79	2 25	1 80	2 99	1.48	797
Total, . .	$14 28	$7 19	$5 75	$8 53	–	–

Composition of Fodder Articles fed during the Above-described Feeding Experiment.

Corn Meal (Average).

1890-91.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	13.26	265.20	–	–	1 : 8.62
Dry matter, ...	86.74	1,734.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.72	34.40	–	–	
" cellulose, . . .	2.28	45.60	21.89	48	
" fat, ...	4.90	98.00	83.30	85	
" protein (nitrogenous matter), . . .	12.94	258.80	204.45	79	
Non-nitrogenous extract matter, ...	78.16	1,563.20	1,531.94	98	
	100.00	2,000.00	1,841.58	–	

Composition of Fodder Articles, etc. — Continued.

Wheat Bran (Average).

1890-91.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.11	242.20	-	-	1 : 3.86
Dry matter,	87.89	1,757.80	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude ash,	7.40	148.00	-	-	
" cellulose,	12.17	243.40	58.42	24	
" fat,	5.04	100.80	71.57	71	
" protein (nitrogenous matter),	18.48	369.60	288.29	78	
Non-nitrogenous extract matter,	56.91	1,138.20	876.41	77	
	100.00	2,000.00	1,294.69	-	

Cotton-seed Meal (Average).

1890-91.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.77	195.40	-	-	1 : 1.37
Dry matter,	90.23	1,804.60	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude ash,	8.18	163.60	-	-	
" cellulose,	7.74	154.80	-	-	
" fat,	11.33	226.60	199.41	88	
" protein (nitrogenous matter),	44.41	888.20	754.97	85	
Non-nitrogenous extract matter,	28.34	566.80	538.46	95	
	100.00	2,000.00	1,492.84	-	

Composition of Fodder Articles, etc. — Continued.

Old-process Linseed Meal.

1890-91.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.72	174.40	-	-	1 : 1.93
Dry matter,	91.28	1,825.60	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude ash,	5.96	119.20	-	-	
" cellulose,	8.23	164.60	42.79	26	
" fat,	9.87	197.40	179.63	91	
" protein (nitrogenous matter),	36.19	723.80	629.70	87	
Non-nitrogenous extract matter,	39.75	795.00	723.45	91	
	100.00	2,000.00	1,575.57	-	

Gluten Meal.

1890-91.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.90	218.00	-	-	1 : 2.11
Dry matter,	89.10	1,782.00	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude ash,	1.02	20.40	-	-	
" cellulose,	1.28	25.60	15.87	62	
" fat,	7.36	147.20	125.12	85	
" protein (nitrogenous matter),	34.79	695.80	549.68	79	
Non-nitrogenous extract matter,	55.55	1,111.00	1,011.01	91	
	100.00	2,000.00	1,701.68	-	

Composition of Fodder Articles, etc. — Continued.

Rowen (Average).

1890-91.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds	Pounds Digestible in a Ton of 2,000 Pounds	Per Cent. of Digestibility of Constituents	Nutritive Ratio.
Moisture at 100° C.,	13.90	278.00	-	-	1 : 6.35
Dry matter,	86.10	1,722.00	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude ash,	8.28	165.60	-	-	
“ cellulose,	28.88	577.60	369.66	64	
“ fat,	3.91	78.20	35.97	46	
“ protein (nitrogenous matter),	13.45	269.00	166.78	62	
Non-nitrogenous extract matter,	45.48	909.60	600.34	66	
	100.00	2,000.00	1,172.75	-	

Corn and Soja Bean Ensilage.

1890-91.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	71.03	1,420.60	-	-	1 : 1.94
Dry matter,	28.97	579.40	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude ash,	11.04	220.80	-	-	
“ cellulose,	27.84	556.80	339.65	61	
“ fat,	5.35	107.00	69.55	65	
“ protein (nitrogenous matter),	15.27	305.40	216.83	71	
Non-nitrogenous extract matter,	40.50	810.00	558.90	69	
	100.00	2,000.00	1,184.93	-	

Composition of Fodder Articles, etc. — Concluded.

Corn Stover.

1890-91.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	19.89	397.80	–	–	1 : 14.84
Dry matter,	80.11	1,602.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.33	126.60	–	–	
" cellulose,	34.59	691.80	498.10	72	
" fat,	1.28	25.60	19.20	75	
" protein (nitrogenous matter),	5.74	114.80	83.80	73	
Non-nitrogenous extract matter,	52.06	1,041.20	697.60	67	
	100.00	2,000.00	1,298.70	–	

3. *Summer Feeding Experiment with Milch Cows, July 6 to Sept. 26, 1891.*

Green feed: vetch and oats, soja beans and fodder corn.

Grain feed: corn meal, wheat bran, dried brewers' grain, gluten meal (Chicago).

The feeding experiment here under discussion is a continuation of similar ones carried on during the summer season in preceding years (since 1887) for the purpose of ascertaining the comparative feeding value and the general economy of various reputed green fodder crops in the dairy industry. Our late observation includes, of green crops, besides vetch and oats and soja beans of former years, as an addition the green fodder corn. The two first named green crops were cut for feed at the beginning of blooming, and they were fed until our supply was either exhausted or until they were fully matured yet still succulent. The green fodder corn was first cut for feed when the kernels were fully developed yet in the milk. The grain feed ration consisted throughout the entire experiment of corn meal and gluten meal, alternating either with wheat bran or dried brewers' grain. The daily ration of grain feed amounted throughout the entire experiment to nine pounds per head; three pounds of corn meal and three pounds of Chicago gluten meal *with either three pounds of wheat bran or with three pounds of dried brewers' grain, for the purpose of comparing the economical merits of these two articles in connection with the production of milk.*

The daily rations of coarse feed consisted of five pounds of rowen — hay of second cut of upland meadows — and of either a mixed green crop of vetch and oats, or of green soja bean or of green fodder corn. The daily consumption per head of grain feed and of hay, as far as quantity is concerned, remained the same in case of every animal during the entire experiment, while that of the green fodder crops was governed by the appetite of each animal on trial. The quantity daily consumed decreased as a rule with their advancing growth, on account of the steady increase of solid matter in the plants. The daily consumption of vetch and oats varied at different feeding periods from 45 to 35 pounds in case of the same animals, and that of soja beans from 44 to 38 pounds, while that of green fodder corn varied from 50 to 38 pounds in case of different animals (fifth feeding period).

A record of the composition and general character of the various fodder constituents of the daily diet will be found farther on.

Five cows, grades of various descriptions and in different milking periods, served in the trial.

The subsequent statement shows the average composition of the daily fodder rations used in the trial during five succeeding feeding periods into which the entire experiment was divided.

Statement of the Average Daily Fodder Rations used during the Different Feeding Periods.

I

Corn meal,	3.00	lbs.
Brewers' grain,	3.00	"
Gluten meal,	3.00	"
Rowen,	5.00	"
Vetch and oats (green),	47.24	"
Total cost,	22.39	cts
Net cost,	12.96	"
Manurial value obtainable,	9.43	"
Nutritive ratio,	1:6.17	

Average Daily Fodder Rations, etc. — Concluded.

II.

Corn meal,	3.00 lbs.
Wheat bran,	3.00 "
Gluten meal,	3.00 "
Rowen,	5.00 "
Vetch and oats (green),	36.42 "
Total cost,	20.91 cts.
Net cost,	12.52 "
Manurial value obtainable,	8.39 "
Nutritive ratio,	1 : 6.29

III.

Corn meal,	3.00 lbs.
Wheat bran,	3.00 "
Gluten meal,	3.00 "
Rowen,	5.00 "
Soja beans (green),	51.28 "
Total cost,	27.18 cts.
Net cost,	17.32 "
Manurial value obtainable,	9.86 "
Nutritive ratio,	1 : 5.07

IV.

Corn meal,	3.00 lbs.
Brewers' grain,	3.00 "
Gluten meal,	3.00 "
Rowen,	5.00 "
Soja beans,	47.34 "
Total cost,	26.31 cts.
Net cost,	16.65 "
Manurial value obtainable,	9.66 "
Nutritive ratio,	1 : 4.76

V.

Corn meal,	3.00 lbs.
Brewers' grain,	3.00 "
Gluten meal,	3.00 "
Rowen,	5.00 "
Fodder corn (green),	39.22 "
Total cost,	20.80 cts.
Net cost,	12.67 "
Manurial value obtainable,	8.13 "
Nutritive ratio,	1 : 6.17

Local Market Cost of the Various Articles of Fodder used (per Ton).

Corn meal,	$31 00
Brewers' grain,	23 00
Wheat bran,	23 00
Gluten meal,	27 00
Rowen,	15 00
Vetch and oats (green),	2 75
Fodder corn (green),	2 50
Soja beans (green),	4 40

Essential Fertilizing Constituents of the Above Fodder Articles.

Nitrogen, 15 cents; phosphoric acid, 5½ cents; potassium oxide, 4½ cents per pound.

	Corn Meal.	Brewers' Grain.	Wheat Bran.	Gluten Meal.	Rowen.	Vetch and Oats.	Fodder Corn.	Soja Beans.
Moisture, . .	15.31	12.00	12.99	11.11	13.90	67.49	71.86	74.23
Nitrogen, . .	1.651	3.299	2.249	4.741	1.853	.459	.343	.565
Phosphoric acid,	.693	1.192	2.793	.413	.464	.202	.195	.183
Potassium oxide,	.426	1.466	1.592	.044	1.966	.487	.430	.297
Valuation per 2,000 pounds, .	$6 10	$12 52	$11 25	$14 72	$7 84	$2 04	$1 63	$2 16

History of Cows (Grades).

NAME.	Breed.	Age (Years).	Last Calf dropped.	Daily Yield of Milk at beginning of Trial (Quarts).	No. of Months on Trial.
Cora, . . .	Grade Jersey, .	7	April 16, 1891,	11–12	3
Pearl, . .	Native, . .	6	Aug. 8, 1890,	8–9	3
Buttercup, . .	Grade Ayrshire,	5	Jan. 2, 1891,	8–9	3
Lucy, . . .	Grade Ayrshire,	5	June 2, 1891,	12–13	3
Clarissa, . .	Grade Durham,	7	March 14, 1891,	9–10	3

Yield of Milk during Different Feeding Periods (Quarts).

	Cora.	Pearl.	Buttercup.	Lucy.	Clarissa.
Period I., ...	11.29	8.11	8.34	12.26	9.49
Period II., ...	11.34	8.70	8.73	12.78	9.31
Period III., ...	11.24	8.63	8.76	12.85	10.37
Period IV., ...	11.57	8.95	8.85	13.26	10.99
Period V., ...	10.70	8.92	8.64	12.01	9.98
Average, ...	11.23	8.66	8.66	12.63	10.03

Conclusions. — The results of the past season obtained in this connection are very encouraging, as will be seen from the subsequent brief abstract when compared with those noticed in preceding years.

1. The yield of milk is well maintained during the entire experiment of three months. The average daily yield of milk of the various cows for the entire experiment is in four out of five cases *larger* than their yield at the beginning of the observation; in the fifth case there is practically no change (Cora). The largest average yield of milk was noticed, without any exception as to a particular cow, in case of soja bean as green fodder and dried brewers' grain as ingredient of the daily grain feed ration (fourth feeding period). Green fodder corn leads in three out of five cases the green vetch and oats when fed with dried brewers' grain.

2. The amount of dry vegetable matter consumed per quart of milk produced varies in case of different cows from 1.77 pounds (Cora) to 3.33 pounds (Pearl). The amount consumed in case of the same cows varies in different feeding periods from 1.77 to 2.25 pounds (Cora) and from 2.44 to 3.17 pounds (Buttercup).

3. The total cost of feed consumed per quart of milk produced differs in case of different animals for the same feeding period from 1.69 to 2.30 cents (Lucy and Pearl, fifth feeding period); as far as different feeding periods are concerned it varies in one case from 1.69 to 2.30 cents (Lucy) and in another case from 2.24 to 2.91 cents (Clarissa).

4. The net cost of feed per quart of milk produced varies from 1.01 to 1.43 cents for the same feeding period in case of different animals (Lucy and Pearl, second feeding period).

5. The obtainable manurial value amounts on an average to three-sevenths of the market cost of the feed consumed. The green vetch and oats leads in this connection.

6. The quality of the milk is in every instance improved in the percentage of solids during the experiment without showing any perceptible decrease in yield. Individuality of the animal and stage of lactation affect the results to a controlling extent.

7. Brewers' grain has served as an excellent substitute for wheat bran in our diet for milch cows.

FEEDING RECORD.

CORA: *Age, seven years; grade Jersey; last calf, April 16, 1891.*

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.								Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds).	Quarts of Milk produced per Day.	Pounds of Dry Matter per Quart of Milk.	Nutritive Ratio.	Average Weight of Animal during Each Feeding Period.
	Corn Meal.	Brewers' Grain.	Wheat Bran.	Gluten Meal.	Rowen.	Vetch and Oats.	Soja Beans.	Fodder Corn.					
1891.													Pounds.
July 6 to July 21, . .	3.00	3.00	-	3.00	5.00	40.75	-	-	25.45	11.29	2.25	1:6.00	1,053
July 24 to Aug. 2, . .	3.00	-	3.00	3.00	5.00	24.30	-	-	20.02	11.34	1.77	1:5.91	1,039
Aug. 6 to Aug. 17, . .	3.00	-	3.00	3.00	5.00	-	44.67	-	23.63	11.24	2.10	1:5.05	1,025
Aug. 21 to Sept. 3, . .	3.00	3.00	-	3.00	5.00	-	42.86	-	23.25	11.57	2.01	1:4.74	1,013
Sept. 7 to Sept. 26, . .	3.00	3.00	-	3.00	5.00	-	-	37.45	22.74	10.71	2.12	1:6.13	1,030

PEARL: *Age, six years; native; last calf, Aug. 8, 1890.*

July 6 to July 18, . .	3.00	3.00	-	3.00	5.00	45.62	-	-	27.03	8.11	3.33	1:6.12	923
July 24 to Aug. 2, . .	3.00	-	3.00	3.00	5.00	35.90	-	-	23.79	8.70	2.73	1:6.29	928
Aug. 6 to Aug 17, . .	3.00	-	3.00	3.00	5.00	-	43.08	-	23.22	8.61	2.69	1:5.05	907
Aug 25 to Sept. 3, . .	3.00	3.00	-	3.00	5.00	-	38.70	-	22.17	8.95	2.48	1:4.72	890
Sept. 7 to Sept. 26, . .	3.00	3.00	-	3.00	5.00	-	-	37.35	22.71	8.92	2.55	1:6.13	864

BUTTERCUP: *Age, five years; grade, Ayrshire; last calf, Jan. 2, 1891.*

July 6 to July 21, . .	3.00	3.00	-	3.00	5.00	43.75	-	-	26.42	8.34	3.17	1:6.08	807
July 24 to Aug. 2, . .	3.00	-	3.00	3.00	5.00	29.60	-	-	21.74	8.73	2.49	1:6.09	840
Aug. 6 to Aug. 17, . .	3.00	-	3.00	3.00	5.00	-	42.17	-	22.99	8.76	2.62	1:5.05	816
Aug. 21 to Sept. 3, . .	3.00	3.00	-	3.00	5.00	-	36.58	-	21.63	8.85	2.44	1:4.70	826
Sept. 7 to Sept. 26, . .	3.00	3.00	-	3.00	5.00	-	-	33.90	21.74	8.64	2.52	1:6.00	864

LUCY: *Age, five years; grade, Ayrshire; last calf, June 2, 1891.*

July 6 to July 21, . .	3.00	3.00	-	3.00	5.00	49.38	-	-	28.25	12.26	2.30	1:6.23	762
July 24 to Aug. 2, . .	3.00	-	3.00	3.00	5.00	44.70	-	-	26.65	12.78	2.09	1:6.52	807
Aug. 6 to Aug. 17, . .	3.00	-	3.00	3.00	5.00	-	61.92	-	28.08	12.85	2.19	1:5.09	790
Aug. 21 to Sept. 3, . .	3.00	3.00	-	3.00	5.00	-	58.50	-	27.28	13.26	2.06	1:4.81	798
Sept. 7 to Sept. 26, . .	3.00	3.00	-	3.00	5.00	-	-	35.75	22.26	12.01	1.85	1:6.01	786

CLARISSA: *Age, seven years; grade, Durham; last calf, March 14, 1891.*

July 6 to July 21, . .	3.00	3.00	-	3.00	5.00	56.69	-	-	30.63	9.49	3.23	1:6.40	889
July 24 to Aug. 2, . .	3.00	-	3.00	3.00	5.00	47.60	-	-	27.59	9.31	2.96	1:6.59	923
Aug. 6 to Aug. 17, . .	3.00	-	3.00	3.00	5.00	-	64.58	-	28.76	10.37	2.77	1:5.10	890
Aug. 21 to Sept. 3, . .	3.00	3.00	-	3.00	5.00	-	60.07	-	27.68	10.99	2.52	1:4.81	882
Sept. 7 to Sept. 26, . .	3.00	3.00	-	3.00	5.00	-	-	51.65	26.73	9.98	2.68	1:6.57	909

TOTAL COST OF FEED PER QUART OF MILK.

Cora.

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Brewers' Grain consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Vetch and Oats consumed (Pounds).	Total Amount of Soja Beans consumed (Pounds).	Total Amount of Fodder Corn consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
1891.												
July 6 to July 21, .	180.70	11.29	48.00	48.00	-	48.00	80.00	652.00	-	-	$3 44	1.90
July 24 to Aug. 2, .	113.30	11.34	30.00	-	30.00	30.00	50.00	243.00	-	-	1 92	1.69
Aug. 6 to Aug. 17, .	134.88	11.24	36.00	-	36.00	36.00	60.00	-	536.00	-	3 09	2.29
Aug. 21 to Sept. 3, .	161.98	11.57	42.00	42.00	-	42.00	70.00	-	600.00	-	3 55	2.19
Sept. 7 to Sept. 26, .	214.19	10.71	60.00	60.00	-	60.00	100.00	-	-	749.00	4 12	1.92

Pearl.

FEEDING PERIODS.	Total Quantity of Milk produced (Quarts).	Average Daily Yield of Milk (Quarts).	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Brewers' Grain consumed (Pounds).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Total Amount of Rowen consumed (Pounds).	Total Amount of Vetch and Oats consumed (Pounds).	Total Amount of Soja Beans consumed (Pounds).	Total Amount of Fodder Corn consumed (Pounds).	Total Cost of Feed consumed.	Average Cost of Feed for Production of One Quart of Milk (Cents).
July 6 to July 18, .	105.46	8.11	39.00	39.00	-	39.00	65.00	593.00	-	-	$2 89	2.74
July 24 to Aug. 2, .	86.98	8.70	30.00	-	30.00	30.00	50.00	359.00	-	-	2 08	2.39
Aug. 6 to Aug. 17, .	103.60	8.63	36.00	-	36.00	36.00	60.00	-	517.00	-	3 05	2.94
Aug. 25 to Sept. 3, .	89.53	8.95	30.00	30.00	-	30.00	50.00	-	387.00	-	2 44	2.73
Sept. 7 to Sept. 26, .	178.49	8.92	60.00	60.00	-	60.00	100.00	-	-	747.00	4 11	2.30

Buttercup.

July 6 to July 21, .	133.50	8.34	48.00	48.00	-	48.00	80.00	700.00	-	-	$3 50	2.62
July 21 to Aug. 2, .	87.33	8.73	30.00	-	30.00	30.00	50.00	296.00	-	-	2 00	2.29
Aug. 6 to Aug. 17, .	105.12	8.76	36.00	-	36.00	36.00	60.00	-	506.00	-	3 02	2.86
Aug. 21 to Sept. 3, .	123.95	8.85	42.00	42.00	-	42.00	70.00	-	512.00	-	3 36	2.71
Sept. 7 to Sept. 26, .	172.79	8.64	60.00	60.00	-	60.00	100.00	-	-	678.00	4 03	2.33

Lucy.

July 6 to July 21, .	196.16	12.26	48.00	48.00	-	48.00	80.00	790.00	-	-	$3 63	1.85
July 21 to Aug. 2, .	127.79	12.78	30.00	-	30.00	30.00	50.00	447.00	-	-	2 20	1.72
Aug. 6 to Aug. 17, .	154.19	12.85	36.00	-	36.00	36.00	60.00	-	743.00	-	3 54	2.30
Aug. 21 to Sept. 3, .	185.58	13.26	42.00	42.00	-	42.00	70.00	-	819.00	-	4 03	2.17
Sept. 7 to Sept. 26, .	240.12	12.01	60.00	60.00	-	60.00	100.00	-	-	715.00	4 07	1.69

Clarissa.

July 6 to July 21, .	151.86	9.49	48.00	48.00	-	48.00	80.00	907.00	-	-	$3 79	2.50
July 21 to Aug. 2, .	93.14	9.31	30.00	-	30.00	30.00	50.00	476.00	-	-	2 21	2.40
Aug. 6 to Aug. 17, .	121.42	10.37	36.00	-	36.00	36.00	60.00	-	775.00	-	3 62	2.91
Aug. 21 to Sept. 3, .	153.84	10.99	42.00	42.00	-	42.00	70.00	-	841.00	-	4 08	2.65
Sept. 7 to Sept. 26, .	199.53	9.98	60.00	60.00	-	60.00	100.00	-	-	1,033.00	4 47	2.24

NET COST OF MILK AND MANURIAL VALUE OF FEED.

Cora.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1891.					Cents.	Pounds.
July 6 to July 21, .	$3 44	$1 78	$1 42	$2 02	1.12	1,080
July 24 to Aug. 2, .	1 92	0 93	0 74	1 18	1.04	1,055
Aug. 6 to Aug. 17, .	3 09	1 39	1 11	1 98	1.47	1,015
Aug. 21 to Sept. 3, .	3 55	1 62	1 30	2 25	1.39	1,032
Sept. 7 to Sept. 26, .	4 12	2 00	1 60	2 52	1.18	1,020
Total, . .	$16 12	$7 72	$6 17	$9 95	–	–

Pearl.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
July 6 to July 18, .	$2 89	$1 50	$1 20	$1 69	1.60	972
July 24 to Aug. 2, .	2 08	1 05	0 84	1 24	1.43	945
Aug. 6 to Aug. 17, .	3 05	1 37	1 10	1 95	1.88	920
Aug. 25 to Sept. 3, .	2 44	1 12	0 90	1 54	1.72	920
Sept. 7 to Sept. 26, .	4 11	2 00	1 60	2 51	1.41	930
Total, . .	$14 57	$7 04	$5 64	$8 93	–	–

Buttercup.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
July 6 to July 21, .	$3 50	$1 82	$1 46	$2 04	1.53	832
July 24 to Aug. 2, .	2 00	0 98	0 78	1 22	1.40	845
Aug. 6 to Aug. 17, .	3 02	1 36	1 09	1 93	1.84	812
Aug. 21 to Sept. 3, .	3 36	1 52	1 22	2 14	1.72	850
Sept. 7 to Sept. 26, .	4 03	1 94	1 55	2 48	1.44	858
Total, . .	$15 91	$7 62	$6 10	$9 81	–	–

Lucy.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
July 6 to July 21, .	$3 63	$1 92	$1 54	$2 09	1.07	793
July 24 to Aug. 2, .	2 20	1 14	0 91	1 29	1.01	835
Aug. 6 to Aug. 17, .	3 54	1 61	1 29	2 25	1.46	785
Aug. 21 to Sept. 3, .	4 03	1 85	1 48	2 55	1.37	815
Sept. 7 to Sept. 26, .	4 07	1 97	1 58	2 49	1.04	765
Total, . .	$17 47	$8 49	$6 80	$10 67	–	–

NET COST OF MILK AND MANURIAL VALUE OF FEED — *Concluded.*

Clarissa.

FEEDING PERIODS.	Total Cost of Feed consumed.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk.	Net Cost of Feed for the Production of Milk.	Net Cost of Feed for the Production of One Quart of Milk.	Weight of Animal at Close of Period.
1891.					Cents.	Pounds.
July 6 to July 21, .	$3 79	$2 04	$1 63	$2 16	1.42	911
July 24 to Aug. 2,	2 24	1 17	0 94	1 30	1.40	930
Aug. 6 to Aug. 17, .	3 62	1 65	1 32	2 30	1.85	890
Aug. 21 to Sept. 3, .	4 08	1 88	1 50	2 58	1.68	907
Sept 7 to Sept. 26, .	4 47	2 23	1 78	2 69	1.35	905
Total, . .	$18 20	$8 97	$7 17	$11 03	–	–

Statement of the Average of Analyses of Milk made during the Different Feeding Periods.

PERIODS.		Cora.	Pearl.	Buttercup.	Lucy.	Clarissa.
I., . .	Solids, per cent.,	13.05	13.96	13.48	13.58	13.59
	Fat, per cent., .	4.24	4.26	3.92	4.29	4.58
II., . .	Solids, per cent.,	12.70	13.55	12.59	13.48	13.16
	Fat, per cent., .	3.98	3.83	3.28	4.26	4.17
III., . .	Solids, per cent.,	12.99	14.63	12.68	13.25	13.43
	Fat, per cent., .	4.39	4.87	3.67	4.27	4.59
IV., . .	Solids, per cent.,	13.68	14.67	12.99	13.98	14.54
	Fat, per cent., .	4.63	4.62	3.58	4.54	4.84
V., . .	Solids, per cent.,	13.30	14.92	13.55	14.33	14.65
	Fat, per cent., .	3.88	4.25	3.83	4.97	4.93

Corn Meal.

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	15.31	303.20	–	–	1 : 9.23
Dry matter, . . .	84.69	1,697.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.72	34.40	–	–	
" cellulose, . . .	2.17	43.40	20.83	48	
" fat, ...	4.84	96.80	82.28	85	
" protein (nitrogenous matter), . .	12.18	243.60	192.44	79	
Non-nitrogenous extract matter, ...	79.09	1,581.80	1,550.16	98	
	100.00	2,000.00	1,845.71	–	

Gluten Meal.

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	11.11	222.20	–	–	1 : 2.66
Dry matter, . . .	88.89	1,777.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.65	33.00	–	–	
" cellulose, . . .	0.73	14.60	9.05	62	
" fat, ...	9.22	184.40	156.74	85	
" protein (nitrogenous matter), . .	33.34	666.80	526.77	79	
Non-nitrogenous extract matter, ...	55.06	1,101.20	1,002.09	91	
	100.00	2,000.00	1,694.65	–	

Brewers' Grain.

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C , . .	12.00	240.00	–	–	1 : 2.95
Dry matter, . . .	88.00	1,760.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	4.46	89.20	–	–	
" cellulose, . . .	15.31	306.20	122.48	40	
" fat, ...	6.10	122.00	101.26	83	
" protein (nitrogenous matter), . .	23.43	468.60	346.76	74	
Non-nitrogenous extract matter, ...	50.70	1,014.00	648.96	64	
	100.00	2,000.00	1,219.46	–	

Wheat Bran.

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	12.99	259.80	–	–	1 : 4.73
Dry matter, . . .	87.01	1,740.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	6.23	124.60	–	–	
" cellulose. . . .	10.47	209.40	50.26	24	
" fat, ...	5.37	107.40	76.25	71	
" protein (nitrogenous matter), . .	16.16	323.20	252.10	78	
Non-nitrogenous extract matter, ...	61.77	1,235.40	951.26	77	
	100.00	2,000.00	1,329.87	–	

Vetch and Oats.

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	64.77	1,295.40	–	–	1 : 10.01
Dry matter, . . .	35.23	704.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	7.97	159.40	–	–	
" cellulose, . . .	30.77	615.40	–	–	
" fat, ...	2.58	51.60	25.80	50	
" protein (nitrogenous matter), . .	8.83	176.60	105.96	60	
Non-nitrogenous extract matter, ...	49.85	997.00	997.00	100	
	100.00	2,000.00	1,128.76	–	

Soja Beans.

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents	Nutritive Ratio.
Moisture at 100° C., . .	72.22	1,444.40	–	–	1 : 5.35
Dry matter, . . .	27.78	555.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	6.39	127.80	–	–	
" cellulose, . . .	31.49	629.80	365.28	58	
" fat, ...	3.39	67.80	9.49	14	
" protein (nitrogenous matter), . .	13.71	274.20	175.49	64	
Non-nitrogenous extract matter, ...	45.06	901.20	549.73	61	
	100.00	2,000.00	1,099.99	–	

Fodder Corn (Green).

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	71.86	1,437.20	–	–	1 : 11.19
Dry matter, ...	28.14	562.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	3.78	75.60	–	–	
" cellulose, ...	25.67	513.40	369.65	72	
" fat, ...	2.24	44.80	33.60	75	
" protein (nitrogenous matter), . .	7.62	152.40	114.30	75	
Non-nitrogenous extract matter, ...	60.69	1,213.80	825.38	68	
	100.00	2,000.00	1,342.93	–	

4. Creamery Record of the Station for the Years 1890 and 1891.

The cost of feed consumed is based on the market price of the various ingredients, as is stated in the subsequent table.

The valuation of the whole milk is taken at three cents per quart. The estimates of the value of fertilizing ingredients contained in the feed are based on those given in the following table.

The local market value and the value of the essential fertilizing constituents of the fodder articles used are reckoned for the year 1890, in order to render the results comparable.

Local Market Value per Ton of the Various Articles of Fodder used.

Corn meal, ...	$23 00
Wheat bran, ...	21 50
Gluten meal, ...	23 00
Brewers' grain, ...	22 00

Local Market Value per Ton, etc. — Concluded.

New-process linseed meal,	$26 00
Old-process linseed meal,	27 00
Cotton-seed meal,	26 00
Hay,	15 00
Rowen,	15 00
Corn fodder,	5 00
Corn stover,	5 00
Corn ensilage,	2 25
Corn and soja bean ensilage,	3 50
Soja bean (green),	4 40
Vetch and oats (green),	2 75
Fodder corn (green),	2 50
Carrots,	7 00
Sugar beets,	5 00
Cabbages,	2 50

Valuation of the Essential Fertilizing Constituents of the Various Articles of Fodder used.

Nitrogen, 16½ cents; phosphoric acid, 6 cents; potassium oxide, 4½ cents per pound.

	Nitrogen.	Phosphoric Acid.	Potassium Oxide.	Valuation per Ton.
Corn meal,	1.86	0.77	0.45	$7 44
Wheat bran,	2.82	3.05	1.49	14 24
Gluten meal,	5.22	0.40	0.05	17 75
Brewers' grain,	3.299	1.192	1.466	13 56
New-process linseed meal,	6.25	1.42	1.16	23 32
Old-process linseed meal,	5.33	1.64	1.16	20 54
Cotton-seed meal,	6.467	2.33	1.723	25 60
Hay,	1.25	0.464	2.085	6 46
Rowen,	1.93	0.364	2.86	9 24
Corn fodder (dry),	1.37	0.368	0.355	5 26
Corn stover (dry),	0.78	0.09	0.599	3 19
Corn ensilage,	0.36	0.14	0.33	1 64
Corn and soja bean ensilage,	0.708	0.42	0.444	3 22
Soja bean (green),	0.590	0.193	0.311	2 44
Vetch and oats (green),	0.23	0.09	0.79	1 54
Fodder corn (green),	0.343	0.195	0.43	1 73
Carrots,	0.14	0.10	0.54	1 04
Sugar beets,	0.29	0.03	0.18	1 15
Cabbages,	0.300	0.11	0.43	1 48

The value of cream is that granted us from month to month by our local creamery association. The station has no other connection with the financial management of the creamery.

Our presentation of financial results is based on the local cost of feed alone, and does not consider interest on investment and labor involved, for the reason that approximate estimates on these points are in an exceptional degree dependent on quality of stock and varying local circumstances. The details are embodied in a few subsequent tables under the following headings : —

1. Statement of articles of fodder used.
2. Record of average quality of milk and of fodder rations.
3. Value of cream produced at creamery basis of valuation.
4. Cost of skim-milk at the selling price of three cents per quart of whole milk.
5. Fertilizing constituents of cream.
6. Some conclusions suggested by the records.
7. Analyses of cream, and modes of analysis of milk, cream and butter.

Statement of Articles of Fodder used during 1890 (in Pounds).

	Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	New-process Linseed Meal.	Cotton-seed Meal.	Hay.	Rowen.	Fodder Corn.	Corn Stover.	Corn Ensilage.	Vetch and Oats.	Soja Beans.	Carrots.	Sugar Beets.
January,	604.50	604.50	-	604.50	-	-	1,016.00	-	-	-	7,737.50	-	-	-	-
February,	370.50	546.00	-	529.75	-	-	514.00	-	850.50	-	4,687.50	-	-	1,080.00	-
March,	-	604.50	-	604.50	-	-	-	-	1,132.00	1,665.00	-	-	-	3,680.00	-
April,	184.50	577.50	-	106.50	444.00	-	977.00	-	1,201.50	472.50	-	-	-	2,520.00	1,080.00
May,	604.50	604.50	-	340.50	262.50	-	2,656.50	360.00	-	-	-	-	-	-	3,240.00
June,	585.00	585.00	-	379.50	204.00	-	-	3,723.50	-	-	-	-	-	-	-
July,	604.50	604.50	-	-	604.50	-	725.50	613.00	-	-	-	7,463.00	-	-	-
August,	604.50	604.50	-	-	604.50	-	930.00	-	-	-	-	910.50	8,882.50	-	-
September,	585.00	585.00	-	-	585.00	-	120.00	2,935.00	-	-	-	-	1,767.00	-	-
October,	571.50	571.50	-	-	223.50	348.00	-	3,221.50	-	-	-	-	-	-	-
November,	450.00	450.00	120.00	-	-	330.00	-	3,555.50	-	-	-	-	-	-	-
December,	465.00	465.00	255.00	-	-	210.00	-	3,225.00	-	-	-	-	-	-	-

1. *Statement of Articles of Fodder used during 1891 (in Pounds).*

	Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Cotton-seed Meal.	Brewers' Grain.	Hay.	Rowen.	Green Fodder Corn.	Corn Stover.	Mixed Ensilage.	Vetch and Oats.	Soja Beans.	Sugar Beets.	Cabbages.
January,	541.50	541.50	-	244.50	297.00	-	-	2,355.00	-	-	1,614.00	-	-	840.00	-
February,	504.00	504.00	306.00	-	198.00	-	-	857.00	-	-	7,566.00	-	-	-	-
March,	558.00	558.00	450.00	-	108.00	-	-	169.00	-	2,153.50	1,269.00	-	-	-	-
April,	537.00	540.00	-	-	534.00	-	-	1,915.50	-	106.50	-	-	-	-	-
May,	558.00	558.00	450.00	-	108.00	-	-	3,295.00	-	-	-	-	-	-	-
June,	516.00	540.00	516.00	-	-	-	-	2,417.50	-	-	-	-	-	-	-
July,	555.00	180.00	555.00	-	-	378.00	-	1,052.00	-	-	-	7,285.00	-	-	-
August,	558.00	324.00	558.00	-	-	234.00	-	1,032.50	-	-	-	479.00	6,965.00	-	1,820.00
September,	540.00	-	540.00	-	-	540.00	-	690.00	4,504.50	-	-	-	1,011.00	-	1,800.00
October,	558.00	-	222.00	-	-	558.00	2,673.00	-	-	-	-	-	-	680.00	1,560.00

Record of Average Quality of Milk and of Fodder Rations (1890).

1890.	Average Percentage of Solids in Milk.	Average Percentage of Fat in Milk.	Quarts of Milk required to make one Space of Cream.	Nutritive Ratio of Feed.	FEED CONSUMED PER DAY (IN POUNDS).														
					Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	New-process Linseed Meal.	Cotton-seed Meal.	Hay.	Rowen.	Fodder Corn.	Corn Stover.	Corn Ensilage.	Vetch and Oats.	Soja Bean.	Carrots.	Sugar Beets.
January, .	14.18	4.72	1.45	1 : 6.25	3.25	3.25	–	3.25	–	–	5.00	–	–	–	44.74	–	–	–	–
February, .	14.02	4.64	1.51	1 : 6.25	3.25	3.25	–	3.25	–	–	5.00	–	–	–	44.74	–	–	–	–
				1 : 5.14	–	3.25	–	3.25	–	–	–	–	13.74	–	–	–	–	20.00	–
March, .	14.21	4.99	1.57	1 : 5.14	–	3.25	–	3.25	–	–	–	–	13.74	–	–	–	–	20.00	–
				1 : 5.14	–	3.25	–	3.25	–	–	–	–	–	16.00	–	–	–	20.00	–
April, .	13.37	4.42	1.66	1 : 4.95	–	3.25	–	–	3.25	–	–	–	16.13	–	–	–	–	20.00	–
				1 : 5.22	3.25	3.25	–	–	3.25	–	15.90	–	–	–	–	–	–	–	20.00
May, .	13.73	4.38	1.75	1 : 5.22	3.25	3.25	–	–	3.25	–	15.90	–	–	–	–	–	–	–	20.00
				1 : 5.60	3.25	3.25	–	3.25	–	–	15.67	–	–	–	–	–	–	–	20.00
June, .	13.42	4.39	1.76	1 : 5.04	3.25	3.25	–	3.25	–	–	–	20.60	–	–	–	–	–	–	–
				1 : 4.73	3.25	3.25	–	–	3.25	–	–	20.75	–	–	–	–	–	–	–
July, .	13.91	4.45	1.67	1 : 5.96	3.25	3.25	–	–	3.25	–	5.00	–	–	–	–	53.75	–	–	–
August, .	14.65	4.95	1.61	1 : 4.69	3.25	3.25	–	–	3.25	–	5.00	–	–	–	–	–	55.00	–	–
September,	13.47	4.57	1.59	1 : 4.91	3.25	3.25	–	–	3.25	–	–	19.86	–	–	–	–	–	–	–
October, .	13.84	4.82	1.56	1 : 4.91	3.25	3.25	–	–	3.25	–	–	19.86	–	–	–	–	–	–	–
				1 : 4.84	3.00	3.00	–	–	–	3.00	–	19.25	–	–	–	–	–	–	–
November,	14.24	5.02	1.57	1 : 4.60	3.00	3.00	–	–	–	3.00	–	20.00	–	–	–	–	–	–	–
December, .	14.80	5.09	1.61	1 : 5.13	3.00	3.00	3.00	–	–	–	–	18.00	–	–	–	–	–	–	–
				1 : 4.83	3.00	3.00	–	–	–	3.00	–	18.00	–	–	–	–	–	–	–
Averages,	13.99	4.70	1.61	1 : 5.19															

2. *Record of Average Quality of Milk and of Fodder Rations (1891).*

1891.	Average Percentage of Solids in Milk.	Average Percentage of Fat in Milk.	Quarts of Milk required to make One Space of Cream.	Nutritive Ratio of Feed.	Feed consumed (Pounds) per Day.												
					Corn Meal.	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Cotton-seed Meal.	Brewers' Grain.	Hay.	Rowen.	Green Fodder Corn.	Corn Stover.	Corn and Soja Bean Ensilage.	Vetch and Oats.	Soja Beans.
January, . .	14.99	5.19	1.54	1 : 4.83	3.00	3.00	–	3.00	–	–	–	18.00	–	–	–	–	–
				1 : 4.17	3.00	3.00	–	–	3.00	–	–	5.00	–	–	42.00	–	–
February, . .	14.71	5.09	1.76	1 : 4.17	3.00	3.00	–	–	3.00	–	–	5.00	–	–	42.00	–	–
				1 : 4.70	3.00	3.00	3.00	–	–	–	–	5.00	–	–	46.00	–	–
March, . .	14.82	5.00	1.62	1 : 6.74	3.00	3.00	3.00	–	–	–	–	–	–	14.00	–	–	–
April, . .	14.41	5.21	1.53	1 : 5.66	3.00	3.00	–	–	3.00	–	–	–	–	14.00	–	–	–
				1 : 4.49	3.00	3.00	–	–	3.00	–	–	18.00	–	–	–	–	–
May, . . .	13.75	4.39	1.67	1 : 5.14	3.00	3.00	3.00	–	–	–	–	18.00	–	–	–	–	–
June, . .	–	–	1.76	–	–	–	–	–	–	–	–	–	–	–	–	–	–
July, . . .	13.41	4.18	1.78	1 : 6.17	3.00	–	3.00	–	–	3.00	–	5.00	–	–	–	47.00	–
August, . .	13.42	4.22	1.86	1 : 5.07	3.00	3.00	3.00	–	–	3.00	–	5.00	–	–	–	–	51.00
				1 : 4.76	3.00	–	3.00	–	–	–	–	5.00	–	–	–	–	47.00
September, .	13.90	4.15	1.75	1 : 6.17	3.00	–	3.00	–	–	3.00	–	5.00	39.00	–	–	–	–
October, . .	–	–	1.72	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Averages, .	14.18	4.68	1.70	1 : 5.17													

3. *Value of Cream at Creamery Basis of Valuation.*

	Total Cost of Feed consumed.	Total Value of Fertilizing Constituents of Food consumed.	Value of Fertilizing Constituents lost in Cream.	Net Cost of Feed for Production of Cream.	Value of Cream produced.
1890.					
January,	$37 78	$23 07	$0 64	$15 35	$33 99
February,	32 19	19 62	0 69	13 26	36 93
March,	34 38	19 75	0 66	15 29	37 52
April,	38 54	19 75	0 68	19 47	32 40
May,	52 09	25 32	0 73	27 50	33 45
June,	48 63	30 05	0 72	19 30	30 66
July,	41 65	23 90	0 68	18 43	29 04
August,	49 09	27 52	0 73	22 30	39 27
September,	47 43	28 68	0 72	19 47	42 05
October,	44 48	27 82	0 65	17 31	39 92
November,	42 36	26 59	0 58	16 35	34 83
December,	40 20	24 89	0 54	15 85	32 84
Averages,	$42 40	$24 75	$0 67	$18 32	$35 24
1891.					
January,	$41 79	$26 14	$0 60	$16 25	$35 23
February,	36 98	26 85	0 61	10 74	35 49
March,	27 86	17 66	0 69	10 89	42 44
April,	35 96	23 22	0 63	13 37	37 36
May,	43 70	26 64	0 74	17 80	40 82
June,	35 80	21 51	0 68	14 97	32 40
July,	36 76	21 30	0 66	16 12	32 26
August,	44 88	25 92	0 68	19 64	36 26
September,	33 64	20 11	0 68	14 21	41 84
October,	43 18	22 30	0 63	21 51	39 48
Averages,	$38 06	$23 17	$0 66	$15 55	$37 36

4. *Cost of Skim Milk at the Selling Price of Three Cents per Quart for Whole Milk.*

	Quarts of Milk produced.	Spaces of Cream.	Quarts of Cream (One Quart equals 3.4 Spaces).	Quarts of Skim-milk.	Value of Cream per Space (Cents).	Value of Cream per Quart of Milk (Cents).	Total Value of Cream.	Cost of Skim-milk per Quart (Whole Milk at Three Cents per Quart).	Total Cost of Skim-milk.
1890.								Cents.	
January,	1,404.1	971	285.6	1,118.5	3.50	2.42	$33 99	0.73	$8 13
February,	1,596.2	1,055	310.3	1,285.9	3.50	2.31	36 93	0.85	10 96
March,	1,594.8	1,014	298.2	1,296.6	3.70	2.35	37 52	0.80	10 32
April,	1,720.8	1,035	304.4	1,416.4	3.13	1.88	32 40	1.36	19 22
May,	1,946.7	1,115	327.9	1,618.8	3.00	1.72	33 45	1.54	24 95
June,	1,922.4	1,095	322.1	1,600.3	2.80	1.59	30 66	1.69	27 01
July,	1,727.0	1,037	305.0	1,422.0	2.80	1.68	29 04	1.60	22 77
August,	1,809.5	1,122	330.0	1,479.5	3.50	2.17	39 27	1.02	15 02
September,	1,747.4	1,098	322.9	1,424.5	3.83	2.41	42 05	0.73	10 37
October,	1,556.9	998	293.5	1,263.4	4.00	2.56	39 92	0.54	6 79
November,	1,413.5	893	262.6	1,150.9	3.90	2.46	34 83	0.66	7 57
December,	1,321.6	821	241.5	1,080.1	4.00	2.48	32 84	0.61	6 81
Averages,	1,646.7	1,021	300.3	1,346.4	3.47	2.17	$35 24	1.01	$14 16
1891.									
January,	1,413.5	915	269.1	1,144.4	3.85	2.49	$35 23	0.63	$7 18
February,	1,643.8	934	274.7	1,369.1	3.80	2.16	35 49	1.01	13 82
March,	1,700.2	1,048	308.2	1,392.0	4.05	2.50	42 44	0.62	8 57
April,	1,468.1	958	281.8	1,186.3	3.90	2.54	37 36	0.56	6 68
May,	1,889.7	1,134	333.2	1,556.5	3.60	2.16	40 82	1.02	15 87
June,	1,841.3	1,045	307.4	1,533.9	3.10	1.76	32 40	1.49	22 84
July,	1,791.2	1,008	296.5	1,494.7	3.20	1.80	32 26	1.44	21 48
August,	1,924.0	1,036	304.7	1,619.3	3.50	1.88	36 26	1.33	21 46
September,	1,826.9	1,046	307.8	1,519.1	4.00	2.29	41 84	0.85	12 97
October,	1,659.9	963	283.2	1,376.7	4.10	2.38	39 48	0.75	10 32
Averages,	1,715.9	1,009	296.7	1,419.2	3.71	2.20	$37 36	0.97	$14 12

5. *Fertilizing Constituents of Cream.*

[Average analysis.]

	Per Cent.
Moisture at 100° C.,	75.22
Nitrogen (16½ cents per pound),	.54
Potassium oxide (4¼ cents per pound),	.123
Phosphoric acid (6 cents per pound),	.168

6. *Conclusions.*

1. The nutritive ratio of the feed varied in 1890 from 1 : 4.60 to 1 : 6.25, with an average of 1 : 5.19 ; in 1891 from 1 : 4.17 to 1 : 6.74, with an average of 1 : 5.17.

2. The amount of fat in the milk varied in 1890 from 4.38 per cent. to 5.09 per cent., with an average of 4.70 per cent. ; in 1891 it varied from 4.15 per cent. to 5.21 per cent., with an average of 4.68 per cent.

3. The percentage of total solids varied in 1890 from 13.37 to 14.80 ; in 1891 from 13.41 to 14.99, with an average for 1890 of 13.99 and for 1891 of 14.18.

4. The total cost of feed for one quart of cream amounts in 1890 to 14.12 cents, and in 1891 to 12.83 cents.

5. The net cost of feed for one quart of cream amounts in 1890 to 6.10 cents, and in 1891 to 5.24 cents.

6. The value received for one space of cream varied in 1890 from 3 to 4 cents, with an average of 3.47 cents ; in 1891 from 3.10 to 4.10 cents, with an average of 3.71 cents, which amounts per quart (average) in 1890 to 11.80 cents and in 1891 to 12.61 cents.

7. The number of quarts of milk required to produce one space of cream in 1890 was 1.61, and in 1891, 1.70, or 5.47 quarts of whole milk to produce one quart of cream in 1890 and 5.78 quarts to produce one quart of cream in 1891.

8. The net cost of feed per quart of cream averages in 1890, 6.10 cents and in 1891, 5.24 cents. We received per quart of cream in 1890, 11.80 cents and in 1891, 12.61 cents, thereby securing a profit of 5.70 cents per quart in 1890 and 7.37 cents in 1891.

From these statements it appears, as has already been claimed in previous reports, that close fodder rations tend to improve the quality of the milk as well as the condition of the animal. The introduction of dried brewers' grain and cotton-seed meal into the daily diet has apparently lowered to a considerable extent the net cost of feed.

For further details concerning results in preceding years, see seventh annual report, pages 82 to 84, and also eighth annual report, pages 54 to 65.

Our average statements for the current year apply in each case to only ten months, due to the fact that financial settlement with our local creamery is made two months after cream is furnished.

7. *Creamery Record, 1891. — Analyses of Cream and Butter Fat.*

Date of Sampling.	Analysis of Cream.			Analysis of Fat.		Average Daily Fodder Rations.
	Solids.	Fat.	Solids not Fat.	Volatile Acids.	Non-volatile Acids.	
1891.						
Jan. 20, .	27.14	18.54	8.60	7.54	84.49	3 pounds corn meal, 3 pounds wheat bran, 3 pounds cotton-seed meal, 10 pounds rowen, 16 pounds mixed ensilage (corn and soja beans).
" 30, .	29.35	19.60	9.75	6.72	86.98	
Feb. 3, .	27.57	18.60	8.97	6.78	86.48	3 pounds corn meal, 3 pounds wheat bran, 3 pounds cotton-seed meal, 5 pounds rowen, 45 pounds mixed ensilage.
" 10, .	27.53	19.17	8.36	7.43	86.25	
Feb. 17, .	28.26	19.88	8.38	7.49	86.30	3 pounds corn meal, 3 pounds wheat bran, 3 pounds gluten meal, 5 pounds rowen, 50 pounds mixed ensilage.
" 24, .	27.41	20.76	6.65	7.32	86.10	
March 3, .	27.29	19.34	7.95	-	-	
March 11, .	26.82	18.98	7.84	-	-	3 pounds corn meal, 3 pounds wheat bran, 3 pounds gluten meal, 15 pounds corn stover.
" 17, .	26.53	18.63	7.90	-	-	
" 24, .	24.65	16.73	9.92	-	-	
March 31, .	24.74	17.53	7.21	6.14	88.89	3 pounds corn meal, 3 pounds wheat bran, 3 pounds cotton-seed meal, 15 pounds corn stover.
April 7, .	26.63	18.58	8.05	6.24	87.89	
" 13, .	26.75	18.84	7.91	6.52	88.32	
April 21, .	25.95	18.09	6.86	-	-	3 pounds corn meal, 3 pounds wheat bran, 3 pounds cotton-seed meal, 20 pounds rowen.
" 28, .	26.61	18.98	7.63	-	-	
May 5, .	27.36	19.56	7.80	-	-	
May 12, .	26.32	18.63	7.69	-	-	3 pounds corn meal, 3 pounds wheat bran, 3 pounds gluten meal, 18 pounds rowen.
" 19, .	25.68	18.11	7.57	-	-	
" 26, .	28.01	20.09	7.92	-	-	
July 14, .	24.65	17.30	7.35	-	-	3 pounds corn meal, 3 pounds brewers' grain (dry), 3 pounds gluten meal, 5 pounds rowen, 45 pounds vetch and oats (green).
" 23, .	24.27	16.45	7.82	-	-	
Aug. 11, .	25.21	18.12	7.09	-	-	3 pounds corn meal, 3 pounds wheat bran, 3 pounds gluten meal, 5 pounds rowen, 42 pounds soja beans (green).
" 18, .	25.93	18.41	7.52	-	-	

Creamery Record, 1891. — Analyses of Cream of Butter.

DATE OF SAMPLING.	Solids.	Fat.	Solids not Fat.	AVERAGE DAILY FODDER RATIONS.
1891.				
Aug. 25, .	27.44	19.27	8.17	3 pounds corn meal, 3 pounds brewers' grain (dry), 3 pounds gluten meal, 5 pounds rowen, 42 pounds soja beans (green).
Sept. 1, .	25.52	18.15	7.37	
Sept. 15, .	23.01	15.69	7.32	3 pounds corn meal, 3 pounds brewers' grain, 3 pounds gluten meal, 5 pounds rowen, 35 pounds fodder corn (green).
" 22, .	25.18	17.56	7.62	
Dec. 8, .	22.15	15.67	6.48	3 pounds maize feed, 3 pounds cotton-seed meal, 3 pounds wheat bran, 16 pounds sweet corn stover.
" 15, .	25.03	18.14	6.89	
" 22, .	24.33	17.71	6.62	
Dec. 29, .	25.97	18.66	7.31	3 pounds maize feed, 3 pounds cotton-seed meal, 3 pounds wheat bran, 14 pounds dent corn stover.

Method of Milk Analysis.

Total Solids. — Evaporate a known quantity of milk (approximately 5 grams) in a weighed porcelain dish, containing 15 to 20 grams of pure, dry sand, on the water bath until apparently dry, then transfer to the air bath and dry at 100° to 105° C. to a constant weight, weighing at intervals of about an hour. In case of cream, use 2.5 to 3 grams for evaporation.

Fat. — Pulverize the sand containing the solids without removing from the dish, subsequently transfer to a filter, and exhaust with anhydrous, alcohol-free ether. Dry the fat obtained on the evaporation of the ether in an air bath at 100° to 105° C. to a constant weight.

Ash. — A weighed quantity of milk is evaporated to dryness with a few drops of nitric acid, and burned in a muffle at a low red heat until free from carbon.

Methods of Butter Analysis.

(1) *Moisture.* — Two and five-tenths to 3 grams are dried at 100° C. in an air bath.

(2) *Salt.* — Six to 7 grams of the butter are washed into a separatory funnel with hot water, and are well shaken, and

allowed to stand until the fat has collected on top; the water is then drawn off, and a fresh quantity added, and shaken up with the butter. This is continued until 200 to 300 cubic centimetres of water have passed through the funnel. The washings are mixed, and made up to 500 cubic centimetres, and the chlorine determined in an aliquot part by means of silver nitrate. From the chlorine the salt is readily calculated.

(3) *Fat.* — Two and five-tenths to 3 grams of the fat freed from salt by the above operation (2), and from water by drying in the air bath, are dissolved in ether, and filtered from the curd into a tared flask. The ether is driven off, and the residual fat dried and weighed. In calculating the per cent., allowance is made for salt and water removed.

(4) *Casein.* — The residue remaining on the filter in (3) is tested for nitrogen by the Kjeldahl method. The factor 6.33 is used in reducing the per cent. of nitrogen found to casein.

Method for determining Volatile and Non-volatile Fatty Acids contained in Butter.

The sample is prepared by churning the cream in a suitable bottle, washing the butter well with cold water, melting at 50 ° C. and filtering from the curd through a hot-water funnel. The fat is then heated in the air bath until free from water.

The method pursued in the determination of the volatile and non-volatile fatty acids is essentially that described by L. F. Nilson, in "Zeit. f. Anal. Chemie," 28, 2, 176.

Two and eight-tenths cubic centimetres to 2.9 cubic centimetres (approximately 2.5 grams) are measured into a tared Erlenmeyer flask of 250 cubic centimetres capacity, and the exact weight determined. Saponification is accomplished by adding 1 gram of potassium hydrate dissolved in 2 cubic centimetres of water, and 5 cubic centimetres of strong (95 per cent.) alcohol. The flask is provided with a reflux condenser, and heated until saponification is complete. The alcohol is then driven off, the last traces being removed by means of the following device: the flask is provided with a double perforated rubber cork, one hole carrying a glass tube reaching nearly to the bottom of the flask and provided above with a short rubber tube carrying a pinch-cock, the other connected by means of a rubber tube with a suction pump. By alternately opening and closing the pinch-cock while the pump is working, the last traces of alcohol can be readily removed from the soap.

Dissolve the soap thus obtained in 30 cubic centimetres of warm water, decompose with 20 cubic centimetres of a 20 per cent. solution of orthophosphoric acid, distil off the volatile acids through a condenser, filtering the distillate, and titrate with decinormal sodium hydrate, using phenolphthalein as indicator. The volatile acids are expelled from the flask by a current of steam. When the distillate amounts to 500 cubic centimetres, the operation is considered to be complete. The volatile acids are calculated as butyric.

The condenser and connections are rinsed back into the flask with boiling water, and the non-volatile acids washed with hot water, and filtered when cool through the same filter that was used for the distillate. The washing is continued until no traces of phosphoric acid are left in the distillate. The filter is then exhausted with hot alcohol, allowing the solution to run into the flask. The alcohol is driven off on the water bath, and the non-volatile fatty acids dried at 100° C. in the air bath until they begin to gain weight.

5. *Some General Remarks on Analysis of Fodder and Fodder Analyses.*

The application of an intelligently devised system of chemical tests, for the purpose of ascertaining the amount and the relative proportions of the essential proximate constituents of our fodder articles, has rendered valuable services to practical agriculture. The chemical analysis of plants during their successive stages of growth has shown marked alterations in their composition, as far as the *absolute amount* of vegetable matter, as well as the *relative proportion* of the essential plant constituents, are concerned. It has rendered not less conspicuous the important influence which the soil in its varying state of fertility exerts on the quantity and the quality of the growth raised upon it. The lessons derived from this source of information have stimulated inquiries concerning the safest modes of manuring, of cultivating and of harvesting our different farm crops with the prospect of securing the most satisfactory returns under existing circumstances.

A better knowledge regarding the particular quality of the various articles of fodder at our disposal improves our chances of supplementing them judiciously and thus economically for different kinds of farm live-stock, as well as for different conditions and functions of the same kind. It furnishes, also, a safer basis for the explanation of the results obtained in actual feeding experiments. To study the nutritive value or feeding effect of any of our fodder articles by actual feeding experiments, without learning, as far as practicable, something more definite regarding its peculiar quality or composition, deprives the results obtained largely of their general interest, for they are secured under ill-defined circumstances. The chemical analysis of an article of fodder is for these reasons considered the first step required to render an intelligent interpretation of the results in feeding trials possible.

Food Constituents. — Actual feeding experiments have shown that *three groups of plant constituents*, namely, *nitrogenous*, *non-nitrogenous* and *mineral constituents*, are *needed* to successfully sustain animal life. No one or two of them, alone, can support it for any length of time. In case the food does not contain digestible non-nitrogenous substances, the fat and a portion of the muscles of the animal on trial will be consumed in the support of respiration before its life terminates. In case digestible nitrogenous constituents are excluded from the diet, the formation of new blood and flesh from the food consumed ceases; for the animal system, according to our present state of information, is not capable of producing its principal constituents from anything else than the nitrogenous constituents of the plants.

Herbivorous animals receive these substances directly from the plants; carnivorous animals indirectly, by feeding on herbivorous animals. We feed, at present, our farm-stock too frequently, without a due consideration of the general natural law of nutrition; to deal out our fodder crops only with mere reference to name, instead of making ourselves more familiar with their composition and their particular quality, deprives us even of the chance of drawing an intelligent conclusion from our present system of feeding.

To compound the animal diet with reference to the particular organization of the animal, its age and its functions, is of no more importance than to select the fodder substances with reference to its special wants, as far as the absolute and relative quantity of the three essential groups of food constituents are concerned.

The peculiar character of our home-raised fodder articles is apt to conceal their special deficiency for the various purposes they are used for in general farm management. They all contain the three essential food constituents, yet in widely varying proportions; and they ought, therefore, to be supplemented in different directions to secure their full economical value. To resort to more or less of the same fodder article to meet the special wants may meet the case as far as an efficient support of the animal is concerned, yet it can only in exceptional cases be considered good economy.

Fodder Rations. — To satisfy the craving of the stomach and to feed a nutritious food are both requirements of a healthy animal diet, which, each in its own way, may be complied with. The commercial fodder substances — as oil-cakes, mill refuse brans, and our steadily increasing supply of refuse materials from breweries, starch works, glucose factories, etc. — are admirably fitted to supplement our farm resources for stock feeding; they can serve in regard to animal growth and support, in a similar way as the commercial fertilizers in the growth of our farm crops, by supplementing our home manurial resources. To feed an excess of food materials, as roots, potatoes, etc., which contain a large proportion of non-nitrogenous matter, as starch, sugar, digestible cellular substance, etc., means direct waste, for they are ejected by the animal, and do not even materially benefit the manure heap. In case of an excessive consumption of nitrogenous constituents, — as oil-cakes, brans, gluten meal, etc., — a part of the expense is saved in an increased value of the manure obtained, yet scarcely enough to recommend that practice beyond merely exceptional cases. The aim, therefore, of an economical stock-feeding must be to compound our various fodder materials in such a manner that the largest quantity of each of the three above-stated groups of fodder substances, which the animal is capable of assimilating, should be contained in its daily diet to meet the purpose for which it is kept.

To compound the fodder rations of our farm stock, with reference to the special wants of each class of them, is an essential requirement for a satisfactory performance of their functions; to supply these wants in an economical way controls the financial success of the industry. From these and similar considerations it will be apparent that the development of a more rational, and thus more economical, system of feeding farm live-stock requires the following kind of information: —

First. How much of each of the three essential groups of food constituents is contained in the fodder we feed?

Second. How much of each of these essential food constituents is digestible under existing circumstances, and is thus directly available to the particular animal on trial?

Third. How much of each of the three essential food constituents does each kind of animal require to secure the best results?

More than twenty-five years have passed by since these questions have seriously engaged the attention of skilful experimenters. Sufficient valuable information has been secured in the course of time to encourage the use of the adopted methods of observation, and to impart to many of the conclusions arrived at a just claim for a serious consideration on the part of practical agriculturists. The fact that much needs still to be learned to meet the reasonable expectations of those engaged in the development of a more economical system of feeding farm live-stock cannot be considered a valid reason why we should not make an intelligent use of what we have learned.

Fodder Analysis. — The chemical analysis of a fodder article is carried on with a view to determine the quantity of each group of its constituents, which is considered an essential ingredient of a complete food for the support of animal life. Our modes of analyzing articles of fodder are practically the same, wherever this work is carried out intelligently. The results obtained are, therefore, applicable for the determining of a comparative value wherever the identity of the material can be established.

The actual results of the analysis are usually reported under the following headings: —

1. Amount of moisture lost at 110° C., or 230° F., and amount of dry matter left behind.
2. Amount of mineral matter left behind after a careful incineration of the material.
3. Amount of organic nitrogenous matter, commonly called crude protein.
4. Amount of non-nitrogenous organic matter, exclusive of fat and of coarse cellulose substances.

The entire mass which any fodder substance leaves behind after being heated at one hundred and ten degrees, Centigrade thermometer, is called dry matter. An increase in dry substance in case of any plant or part of plant at the same stage of growth indicates usually a higher feeding value. To satisfy the cravings of the animal, a certain quantity or bulk of coarse, dry matter becomes an important consideration in making up the fodder rations for different classes of animals. In raising young stock for fattening purposes, a liberal supply is also desirable, to effect a proper distension of the digestive organs, to make them good feeders hereafter.

Nitrogenous substances, or protein matter, refer to several groups of nitrogen-containing compounds, of plants in particular, as albumin, fibrin, legumin, basein, etc., which are essential for the formation of blood and tissues. Those contained in animal matter, as meat refuse, are frequently considered of a higher value than those in many plants.

Non-nitrogenous substances include, in particular, starch, sugars, organic acids, gums, fats and the digestible portion of the cellular matter of the fodder. These substances are readily transformed within the digestive organs into soluble compounds of a similar chemical character, and are thus assumed to serve an identical physiological purpose. As more recent investigations have shown a superior physiological value of fat, — one of the non-nitrogenous constituents, — two and one-half times as much as starch, sugar, and other representatives of that group, its amount is separately recorded. The same course, for similar reasons, has of late been adopted with reference to certain forms of nitrogenous organic constituents of fodder articles.

Fatty substances include all the various natural fats of the plant. Most plants contain more than was assumed at an earlier stage of inquiry. As the fat is separated by means of ether, the statements in the analyses do not exactly express the amount of fatty matter alone, but include more or less resinous substances, wax, etc., which are largely soluble in ether, and of a similar highly carbonaceous character. The fat of the fodder seems to serve, in case of judicious fodder rations, mainly to increase the stock of fat in the animal which consumes the fodder.

Digestibility of Fodder. — Wherever the article has been tested by actual feeding experiment under skilful observation, the amount of each essential group of food constituents which has been shown to be digestible is reported in connection with the chemical analysis, under the heading *Digestible Portion*, per hundred weight or per ton. The higher or lower degree of digestibility of a fodder article exerts a decided influence on its nutritive value. Different stages of growth affect the rates of digestibility of the various plant constituents. The same feature is noticed in regard to different parts of plants, as well as in case of different kinds of animals.

More than two hundred fodder articles have thus far been studied under varying circumstances, and most of our current kinds of fodders have been tested in Europe and elsewhere, in numerous well-conducted feeding experiments with a suitable selection of different kinds of farm live-stock. This fact imparts to many of the results recorded a sufficient importance to recommend them as a basis of new feeding trials, with feed stuffs raised in our climate, or obtained in our home industries.

Nutritive Ratio. — The last, but not least important, column of the statement of the chemical analysis — quite frequently found in the general record of a fodder for a practical agricultural purpose — is that of "Nutritive Ratio." These words are used to express the numerical relation of its *digestible nitrogenous substances* taken as one, as compared with the sum of its *digestible non-nitrogenous organic substances,* fat included. The information derived from that statement is very important; for it means to express the summary of results secured by actual feeding trials under specified conditions, and with the aid of the best endorsed chemical modes to account for the constituents of the food before and after it has served for the support of the animal on trial.

Experience has shown that different kinds of animals, as well as the same kind at different ages and for different functions, require a different proportion of the essential groups of food constituents to produce in each case the best results. A statement of the nutritive ratio of a fodder article — otherwise well adapted as an ingredient of a daily diet in the case under consideration — indicates the direction in which the material has to be supplemented to economize to a full extent its various constituents.

Practical trials with milch cows have demonstrated that they require for the highest production of a good milk and the maintenance of a healthy live weight, the most nutritious food we are in the habit of giving to full-grown farm animals. Careful examinations into the composition of an efficient diet for milch cows have shown that it contains one part of digestible nitrogenous matter to from five to five and a half parts of digestible non-nitrogenous organic matter. A due consideration of these facts renders it but natural that a good corn ensilage, which has a nutritive ratio of from 1 to 10 to 1 to 12, needs a liberal addition of substances like oil-cakes, wheat bran, gluten meal, etc., which have a nutritive ratio of 1 to from 2.5 to 4, to secure its full value as an ingredient of a daily diet in the dairy; or that good hay shows less the beneficial effects of an addition of these valuable waste products than that of an inferior quality. The nutritive ratio of hay may vary from 1 to 5.5 to from 1 to 9 or more.

Market Cost and Food Value. — *The value of an article of fodder may be stated from two different stand-points,* — that is, *with reference to its cost in the local market* and *with reference to its nutritive feeding value.* The *market price may be expressed by a definite sum for each locality; it depends on demand and supply in the market*, and it is beyond the control of the individual farmer. *The nutritive value*, or commonly called *food value, of the article cannot be expressed by a definite sum; it varies with a more or less judicious application*, and *depends also, to a considerable degree, on its adaptation under varying circumstances.* To secure the most satisfactory returns from feeding our home-raised fodder crops is as important a question as that of raising them in an economical manner. The great progress which has been made of late in regard to the proper mode of feeding plants ought to serve as an encouragement to undertake the task of inquiring more systemmatically into the proper mode of feeding our farm live-stock in the most profitable way.

Manurial Value of Fodder Articles. — Assuming a similar degree of adaptation of the various fodder articles offered for our choice, the question of cost deserves a serious consideration, when feeding for profit. *The actual cost of a fodder article does not depend merely upon its market price, but is materially affected by the value of the manurial refuse it leaves behind, when it has served its purpose as food.* The higher the percentage of nitrogen, phosphoric acid and potash a diet contains, the more valuable is the manure it furnishes, under otherwise corresponding circumstances. An excess, therefore, of any one or of all three in one diet, as compared with that of another, counts in favor of that particular diet as far as the net cost of feed is concerned; for it is admissible, for mere practical, economical purposes, to assume that, in raising one and the same kind of animals to a corresponding weight, or feeding them for the same purpose, a corresponding amount of nitrogen, phosphoric acid, potassium oxide, etc., will be retained, and, according to circumstances, either stored up in the growing animal or passed into the milk, etc. The commercial value of the three above-mentioned essential articles of plant food, contained in the manure secured in connection with our feeding experiments with milch cows, has differed in case of different diets from less than one-third to more than one-half of the market cost of feed consumed.

As the financial success in a mixed farm management depends, in a considerable degree, on the amount, the character and the money value of the manurial refuse material secured in connection with the special farm industry carried on, it needs no farther argument to prove that the relations which exist between the composition of the fodder and the value of the manure resulting deserve the careful consideration of the farmer when devising an efficient and, at the same time, an economical diet for his live-stock. To assist in a due consideration of this important circumstance a compilation of analyses of a great variety of fodder articles made in the course of years at the Massachusetts Experiment Station has been added to this report in the form of an appendix.

Valuation of Concentrated Commercial Feed Stuffs. — Most of our concentrated feed stuffs, as oil-cakes, brans, middlings, maize feed, gluten meals, starch feed, etc., are by-products of various branches of industry. The articles contain, as a rule, a more liberal amount of nitrogenous food constituents than the materials from which they are obtained, and they are usually bought for the purpose of raising the nitrogen-containing food constituents of the daily diet of our farm live-stock to a desired proportion. This general practice is based on the circumstance that the larger portion of our home-raised coarse fodder articles, as meadow hay, fodder corn, corn stover, corn ensilage, roots, etc., is, comparatively speaking, quite deficient in nitrogen-containing food constituents, to meet, in an economical way, the requirement of an efficient daily diet for dairy stock, hard-worked animals, young farm live-stock of various kinds, etc. The concentrated commercial feed stuffs, if judiciously selected and in a proper mechanical condition, are admirably adapted to add to our home-raised coarse fodder articles that food constituent in which they are deficient, without increasing in an objectionable degree the bulk or volume of the daily fodder ration. They tend thereby to increase, as a rule, materially, the nutritive value of our home-raised coarse fodder articles. Farmers that do not raise a liberal proportion of clover-like fodder plants are, in a particular degree, in need of concentrated commercial feed stuffs rich in nitrogenous food constituents to turn the excess of the non-nitrogenous food constituents, which most of our current home-raised coarse fodder articles contain, to the best possible account.

As we buy, in the majority of cases, the concentrated commercial feed stuffs on account of their large proportion of nitrogen-containing food constituents, it becomes of special interest to know at what cost a given quantity of digestible nitrogen-containing food constituents can be bought in the form of different feed stuffs equally well adapted under existing circumstances. A change in the market cost of one and the same commercial feed stuff affects the cost of the nitrogen-containing food constituent, in particular as its supply is more limited than that of the non-nitrogenous food constituents, which our home-raised coarse fodder articles contain, as a rule, in abundance.

The subsequent tabular statement assumes a constant cost of digestible non-nitrogenous food constituents, — sugar, starch, fat, etc., — and shows thereby the variations in the cost of digestible nitrogen-containing food constituents in case of some prominent concentrated commercial feed stuffs in our local market.

The majority of the analyses stated is made of fodder articles which have been used either during the past year in connection with some of our feeding experiments, or have been raised upon the grounds of the station. Some articles sent on by outside parties are added, on account of the special interest they may present to others.

Valuation of Fodder Articles on the following Basis.

Digestible cellulose and nitrogen free extract matter, 1.00 cent per pound; digestible fat. 2.50 cents per pound. The value of digestible protein determined the difference of the sum of both and the market cost of the fodder articles. (Calculation is based on dry matter, 2,000 pounds.)

	Market Cost.	Protein per Pound.
		Cents.
Corn meal,	$31 00	6.88
Corn meal,	29 00	5.84
Corn meal,	24 00	3.24
Corn meal,	23 00	2.72
Wheat middlings,	20 00	3.13
Spring wheat bran,	19 00	3.04
Winter wheat bran,	21 00	3.93
Chicago maize feed,	23 00	2.34
Dried brewers' grain,	22 00	3.37
Old-process linseed meal,	26 00	2.20
New-process linseed meal,	27 00	2.68
Chicago gluten meal,	28 00	2.46
Cotton-seed meal,	28 00	2.34
English hay,	12 00	1.36
English hay,	15 00	4.12
Rowen,	12 00	1.21
Rowen,	15 00	3.24
Corn stover,*	5 00	–
Corn ensilage,*	2 50	–
Mangold roots,*	3 00	–
Sugar beets,*	5 00	–

* The value of the digestible cellulose, nitrogen free extract matter and fat, on the above basis, exceeds the market cost.

	CORN MEAL.				WHEAT MIDDLINGS.			
	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.
Moisture,	15.31	-	-	1:9.23	10.07	-	-	1:4.54
Dry matter,	84.69	-	-		89.93	-	-	
	100.00	-	-		100.00	-	-	
Analysis of Dry Matter.								
Crude ash,	1.72	-	-		6.99	-	-	
" cellulose,	2.17	48	20.83		9.21	24	44.20	
" fat,	4.84	85	82.28		5.31	71	75.40	
" protein,	12.18	79	192.44		16.72	78	260.83	
N-free extract matter,	79.09	98	1,550.16		61.77	77	951.26	
	100.00	-	1,845.71		100.00	-	1,331.69	

	SPRING WHEAT BRAN.				WINTER WHEAT BRAN.			
	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.
Moisture,	12.74	-	-	1:4.48	13.06	-	-	1:4.36
Dry matter,	87.26	-	-		86.94	-	-	
	100.00	-	-		100.00	-	-	
Analysis of Dry Matter.								
Crude ash,	8.06	-	-		7.76	-	-	
" cellulose,	13.75	24	66.00		12.74	24	61.15	
" fat,	5.46	71	77.53		3.43	71	48.71	
" protein,	16.19	78	252.56		16.24	78	253.34	
N-free extract matter,	56.54	77	870.72		59.83	77	921.38	
	100.00	-	1,266.81		100.00	-	1,284.58	

	CHICAGO MAIZE FEED.				BREWERS' GRAIN.			
	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.
Moisture,	9.75	–	–	1 : 4.49	10.19	–	–	1 : 3.15
Dry matter,	90.25	–	–		89.81	–	–	
	100.00	–	–		100.00	–	–	
Analysis of Dry Matter.								
Crude ash,	0.75	–	–		2.98	–	–	
" cellulose,	9.65	62	119.66		8.07	40	64.56	
" fat,	6.15	85	104.55		5.25	83	87.15	
" protein,	21.33	79	337.01		22.76	74	336.85	
N-free extract matter,	62.12	91	1,130.58		60.94	64	780.03	
	100.00	–	1,691.80		100.00	–	1,268.59	

	OLD-PROCESS LINSEED MEAL.				NEW-PROCESS LINSEED MEAL.			
	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.
Moisture,	8.72	–	–	1 : 1.93	8.29	–	–	1 : 1.74
Dry matter,	91.28	–	–		91.71	–	–	
	100.00	–	–		100.00	–	–	
Analysis of Dry Matter.								
Crude ash,	5.96	–	–		5.91	–	–	
" cellulose,	8.23	26	42.79		9.43	26	49.04	
" fat,	9.87	91	179.63		4.08	91	74.26	
" protein,	36.19	87	629.70		35.03	87	609.51	
N-free extract matter,	39.75	91	723.45		45.55	91	829.01	
	100.00	–	1,575.57		100.00	–	1,561.82	

	CHICAGO GLUTEN MEAL.				COTTON-SEED MEAL.			
	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.
Moisture,	11.11	-	-	1:2.66	9.77	-	-	1:1.37
Dry matter,	88.89	-	-		90.23	-	-	
	100.00	-	-		100.00	-	-	
Analysis of Dry Matter.								
Crude ash,	1.65	-	-		8.18	-	-	
" cellulose,	0.73	62	9.05		7.74	-	-	
" fat,	9.22	85	156.74		11.33	88	199.41	
" protein,	33.34	79	526.77		44.41	85	754.97	
N-free extract matter,	55.06	91	1,002.09		28.34	95	538.46	
	100.00	-	1,694.65		100.00	-	1,492.84	

	ENGLISH HAY.				ROWEN.			
	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.
Moisture,	9.72	-	-	1:9.68	13.53	-	-	1:6.93
Dry matter,	90.28	-	-		86.47	-	-	
	100 00	-	-		100.00	-	-	
Analysis of Dry Matter.								
Crude ash,	6.43	-	-		6.81	-	-	
" cellulose,	32.28	58	374.45		28.31	58	328.40	
" fat,	2.49	46	22.91		3.81	46	35.05	
" protein,	9.54	57	108.76		12.94	57	147.52	
N-free extract matter,	49.26	63	620.68		48.13	63	606.44	
	100.00	-	1,126.80		100.00	-	1,117.41	

	CORN STOVER.				CORN ENSILAGE.			
	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.
Moisture,	22.50	-	-	1 : 8.62	72.95	-	-	1 : 11.67
Dry matter,	77.50	-	-		27.05	-	-	
	100.00	-	-		100.00	-	-	
Analysis of Dry Matter.								
Crude ash,	3.97	-	-		6.48	-	-	
" cellulose,	34.96	72	503.42		26.33	72	379.15	
" fat,	1.54	75	23.10		5.17	75	77.55	
" protein,	9.76	73	142.50		7.64	73	111.54	
N-free extract matter,	49.77	67	666.92		54.38	67	728.69	
	100.00	-	1,335.94		100.00	-	1,296.93	

	MANGOLD ROOTS.				SUGAR BEETS.			
	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio.	Percentage Composition.	Per Cent. of Digestibility.	Pounds Digestible in a Ton.	Nutritive Ratio
Moisture,	87.75	-	-	1 : 9.94	85.27	-	-	1 : 11.80
Dry matter,	12.25	-	-		14.73	-	-	
	100.00	-	-		100.00	-	-	
Analysis of Dry Matter.								
Crude ash,	9.06	-	-		5.95	-	-	
" cellulose,	7.94	100	158.80		6.49	100	129.80	
" fat,	0.88	100	17.60		0.66	100	13.20	
" protein,	10.37	100	207.40		10.97	100	219.40	
N-free extract matter,	71.75	100	1,435.00		75.93	100	1,518.60	
	100.00	-	1,818.80		100.00	-	1,881.00	

ANALYSES OF FODDER ARTICLES SENT ON BY FARMERS.

Corn Meal.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	13.52
Dry matter,	86.48
	100.00

Analysis of Dry Matter.

Crude ash,	2.34
" cellulose,	2.47
" fat,	4.85
" protein (nitrogenous matter),	15.61
Non-nitrogenous extract matter,	74.73
	100.00

Corn and Cob Meal.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	19.11
Dry matter,	80.89
	100.00

Analysis of Dry Matter.

Crude ash,	2.05
" cellulose,	6.97
" fat,	3.46
" protein (nitrogenous matter),	10.51
Non-nitrogenous extract matter,	77.01
	100.00
Passed screen 144 meshes to square inch,	73.88

Hominy Chop.

[Sent on from Southborough, Mass.]

	Per Cent.
Moisture at 100° C.,	11.32
Dry matter,	88.68
	100.00

Analysis of Dry Matter.

Crude ash,	2.44
" cellulose,	5.12
" fat,	11.26
" protein (nitrogenous matter),	6.77
Non-nitrogenous extract matter,	74.41
	100.00

Wheat Bran.

[Sent on from Amherst, Mass.]

	PER CENT.	
	I.	II.
Moisture at 100° C.,	10.47	13.17
Dry matter,	89.53	86.83
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	7.19	7.95
" cellulose,	11.27	11.22
" fat,	4.80	4.86
" protein (nitrogenous matter),	18.93	17.31
Non-nitrogenous extract matter,	57.81	58.66
	100.00	100.00

I. Wheat Bran (St. Louis).
II. Spring Wheat Bran (Duluth, Minn.).

[Sent on from Warren, Mass.]

	PER CENT.	
	I.	II.
Moisture at 100° C.,	10.12	8.97
Dry matter,	89.88	91.03
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	6.94	7.68
" cellulose,	9.72	10.84
" fat,	4.95	5.37
" protein (nitrogenous matter),	18.08	19.54
Non-nitrogenous extract matter,	60.31	56.57
	100.00	100.00

Ground Barley.

[Sent on from Amherst.]

	Per Cent.
Moisture at 100° C.,	14.62
Dry matter,	85.38
	100.00

Analysis of Dry Matter.

Crude ash,	3.18
" cellulose,	5.04
" fat,	2.38
" protein (nitrogenous matter),	14.93
Non-nitrogenous extract matter,	74.47
	100.00

Gluten Meal.

[From Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	10.90
Dry matter,	89.10
	100.00

Analysis of Dry Matter.

Crude ash,	1.02
" cellulose,	1.28
" fat,	7.36
" protein (nitrogenous matter),	34.79
Non-nitrogenous extract matter,	65.55
	100.00

Cotton-seed Meal.

[Sent on from Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C,	9.07	9.06
Dry matter,	90.93	91.94
	100.00	100.00
Analysis of Dry Matter.		
Crude ash,	7.50	8.11
" cellulose,	6.81	8.69
" fat,	11.17	10.71
" protein (nitrogenous matter),	46.38	41.26
Non-nitrogenous extract matter,	28.14	31.23
	100.00	100.00

Cotton-seed Meal.

[I. sent on from Holden, Mass.; II. and III. sent on from Sunderland, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	8.90	8.50	9.37
Dry matter,	91.10	91.50	90.63
	100.00	100.00	100.00
Analysis of Dry Matter.			
Crude ash,	8.23	–	–
" cellulose,	7.15	–	–
" fat,	12.61	9.60	11.14
" protein (nitrogenous matter),	51.79	50.61	43.86
Non-nitrogenous extract matter,	20.22	–	–
	100.00	–	–

Cocoanut Meal.

[Sent on from Concord, Mass.]

	Per Cent.
Moisture at 100° C.,	9.33
Dry matter,	90.67
	100.00
Analysis of Dry Matter.	
Crude ash,	5.68
" cellulose,	18.80
" fat,	12.88
" protein (nitrogenous matter),	22.61
Non-nitrogenous extract matter,	40.03
	100.00

Hog Feed — Bakery Refuse.

[Sent on from North Hadley, Mass.]

	Per Cent.
Moisture at 100° C.,	13.34
Dry matter,	86.66
	100.00
Analysis of Dry Matter.	
Crude ash,	11.64
" cellulose,	0.43
" fat,	6.36
" protein (nitrogenous matter),	9.23
Non-nitrogenous extract matter,	72.34
	100.00

Hay from Salt Meadows.

[Sent on from Newbury, Mass.]

	PER CENT.		
	I.	II.	III.
Moisture at 100° C.,	9.66	8.08	8.75
Dry matter,	90.34	91.92	91.25
	100.00	100 00	100.00
Analysis of Dry Matter.			
Crude ash,	5.01	5.03	9.03
" cellulose,	27.84	27.82	31.41
" fat,	2.65	3.24	3.37
" protein (nitrogenous matter),	4.35	3.77	6.72
Non-nitrogenous extract matter,	60.15	60.14	49.47
	100.00	100.00	100.00

Methods of Analysis of Cattle Foods.

1. Moisture. — Dry 2 grams in an air-bath at 100–110° C. to a constant weight.

2. Ash. — Char 2 to 5 grams in a muffle furnace at a low red heat, cool and weigh. Digest for a short time with dilute hydrochloric acid; collect the residue insoluble in acid in a Gooch crucible, wash, dry and weigh. Subtract this from the total weight for pure ash.

3. Ether Extract. — Dry 2 grams at 100° C. for two hours. Exhaust with anhydrous, alcohol-free ether, until the extraction is complete. Dry the extract in the air-bath at 100° C. to a constant weight.

4. Crude Protein. — Determine nitrogen by the Kjeldahl or soda-lime method, and multiply the result by 6.25 for crude protein.

5. Albuminoid Nitrogen. — Determine by Stutzer's method, as given in the "Proceedings of the Association of Official Agricultural Chemists," 1890 (pages 211 and 212), except that the protein-copper is dried before being introduced into the flask.

6. Crude Fibre or Cellulose. — The method is described in the "Proceedings of the Association of Official Agricultural Chemists," 1890 (page 212). In this method 2 grams of the material, having been nearly or completely freed from fat, are boiled for thirty minutes with 200 cubic centimetres of $1\frac{1}{4}$ per cent. sulphuric acid, brought upon a linen filter and thoroughly washed with boiling water. It is then washed into the boiling-flask with a $1\frac{1}{4}$ per cent. solution of sodium hydrate, brought quickly to 100° C., and boiled for thirty minutes, when it is filtered through a Gooch crucible, or balanced filter-papers, washed with boiling water, alcohol and ether, dried at 100° C. for an hour, and weighed. The organic matter is then burned off, and the weight of the ash deducted for crude cellulose.

II.

FEEDING EXPERIMENTS WITH STEERS.

The question of a remunerative production of beef for the meat market, upon the farms of New England, has, for several years past, received a deserved attention at the Massachusetts State Agricultural Experiment Station, by carrying on feeding experiments, under well-defined circumstances, with growing steers. The results of observations in that direction during two preceding years are ready for publication. The work is to be continued with such modifications as suggest themselves during its progress, and the conclusions arrived at will be published hereafter, whenever they are found to be of a more general interest to the farming community.

The first experiment, December, 1889, to May, 1890, briefly described upon a few succeeding pages, was planned mainly with a view to determine *the cost of the feed* required for the production of beef for the meat market under existing local conditions, and with special reference to the contemporary local market price of the fodder articles at our disposal.

Current home-raised fodder articles, as fodder corn, corn stover, corn ensilage and sugar beets, served as coarse feed, while corn and cob meal, wheat bran, old-process linseed meal and gluten meal furnished the grain feed for daily diet of the animals on trial. The stated amount of grain feed was in each case a fixed quantity, while the consumption of coarse feed was governed by the appetite of the animal.

One and two year old grade Shorthorn steers, two of each kind, were chosen for the observation. The steers selected were, as far as possible, of a similar general character with reference to breed. They were chosen of a different age to offer a desirable chance to determine *the difference in the cost of the feed* for the production of a corresponding increase in the live weight of both one and two year old animals.

The same kinds of fodder articles served at the same stage of the experiment for all animals engaged in the experiment alike in the compounding of their daily diet; they were, however, given in different proportion and in different quantities to animals of different ages. The daily diet of one and two year old steers was compounded with a due consideration of the wants at the particular age of each lot. Their respective daily diet consequently differed essentially only in regard to quantity and proportion of the same fodder articles.

The local market price of the various fodder articles used at the time of the observation has been adopted as the basis of determining the cost of the daily fodder rations. A loss of eight per cent. of the essential fertilizing constituents contained in the food consumed has been assumed a fair compensation for the amount of nitrogen, phosphoric acid and potassium oxide retained in the growing animal, and thereby lost to the manurial resources of the farm. Accepting E. Wolff's statement of the chemical composition of a live steer as the basis in our calculation of the loss of the above-stated manurial substances, one hundred pounds of increase in the live weight of the steers, at the present market value of phosphoric acid, potassium oxide and nitrogen, represents a loss of from 52 to 55 cents to the manurial resources of the farm. From the previous statement, it will be noticed that ninety-two per cent. of the essential fertilizing constituents contained in the feed consumed are considered available in the manure produced in connection with raising steers for the meat market. The *net cost* of the feed stated in the subsequent report of our financial results represents, therefore, the cost of the feed consumed, after deducting from its original market price ninety-two per cent. of the money value of the essential fertilizing constituents, *i. e.*, nitrogen, phosphoric acid and potassium oxide, it contains.

The statements of the relative proportion of the digestible nitrogenous and non-nitrogenous food constituents of the daily diet (its nutritive ratio) are based on the mean of more recent observations in connection with actual feeding experiments elsewhere (Wolff).

The different daily fodder rations recorded below were compounded with a view to compare different combinations of well-known feed stuffs with reference to feeding effect and to influence on cost of feed. Those daily fodder rations which have given us the most satisfactory results in this connection may be seen below (rations I. and II.).

The general history of the management of the experiment and the financial results of the whole operation are published upon a few subsequent pages. It is for obvious reasons not advisable to enter at this early stage of our experiments upon a detailed critical discussion of the lessons which may be learned from the results obtained. Some facts, however, brought out in the course of the experiment, are apparently so well supported under existing circumstances that a brief statement concerning them may claim some special attention.

Results.

1. Corn ensilage, when fed either with wheat bran and gluten meal, or with wheat bran and old-process linseed meal, has produced in our case, without an exception, the highest gain in live weight, as compared with other fodder rations used in the experiment (see fodder rations I., II., below).

2. The increase in live weight per day, when feeding the ensilage fodder rations (I., II.) to one-year old steers, has in one instance (steer 2) exceeded three pounds, while in the case of two-year old steers it has averaged more than four pounds per day in one case (steer 4).

3. The original cost of the feed (corn ensilage, fodder rations I., II.) consumed per day has been from 12.82 cents to 14.72 cents in case of one-year old steers (1, 2),

and from 16.67 cents to 19.33 cents in case of two-year old steers (3, 4).

4. The net cost of the feed (corn ensilage, fodder rations I., II.) consumed per day has been from 4.81 cents to 5.26 cents in the case of one-year old steers (1, 2), and from 6.65 cents to 7.44 cents in case of two-year old steers.

5. The daily increase in the live weight of the one-year old steers during both periods of feeding ensilage fodder rations (I., II.) averages 2.9 pounds. The original market cost of that diet averages, per day, 13.29 cents, hence the original cost of the feed consumed per pound of live weight gained amounts to 4.8 cents, while the net cost of the feed consumed per pound of live weight gained amounts to 1.82 cents.

6. The daily increase in the live weight of the two-year old steers during both periods of feeding ensilage fodder rations (I., II.) averages 3.45 pounds. The original market cost of that daily diet averages for both periods, per day, 18 cents, hence the original market cost of the feed consumed for every pound of live weight produced amounts to 5.22 cents, while the net cost of the feed consumed per pound of live weight gained amounts to 2.08 cents.

7. The difference in the financial result presented above and of the subsequent financial summaries of the entire feeding experiment is due to the less profitable daily fodder ration used during the experiment in connection with the ensilage fodder rations (I., II.).

Local Market Value per Ton of the Various Articles of Fodder used, 1889-90.

Wheat bran,	$16 50
Gluten meal,	23 00
Old-process linseed meal,	27 50
Corn and cob meal,	16 50
Corn stover,	5 00
Corn ensilage,	2 75
Corn fodder,	7 50
Sugar beets,	5 00

Valuation of Essential Fertilizing Constituents in the Various Articles of Fodder used.

	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Corn and Cob Meal.	Corn Stover.	Corn Ensilage.	Corn Fodder.	Sugar Beets.
Moisture,	9.27	9.80	9.88	8.10	26.95	72.95	20.42	90.02
Nitrogen,	2.545	4.510	5.331	1.439	.923	.330	1.058	.184
Phosphoric acid,	2.900	.392	1.646	.603	.303	1.138	.510	.086
Potassium oxide,	1.637	.049	1.162	.441	1.320	.301	.760	.462
Valuation per 2,000 lbs.,	$13 60	$16 18	$21 15	$6 02	$4 69	$1 56	$4 89	$1 14

Daily Fodder Rations used.

I.

Wheat bran,	3.88	lbs.
Gluten meal,	3.88	"
Corn ensilage,	37.50	"
Nutritive ratio,	1:5.49	
Total cost,	12.82	cts.
Manurial value obtainable,	8.01	"
Net cost,	4.81	"

II.

Wheat bran,	4.00	lbs.
Old-process linseed meal,	4.00	"
Corn ensilage,	43.38	"
Nutritive ratio,	1:5.69	
Total cost,	14.76	cts.
Manurial value obtainable,	9.50	"
Net cost,	5.26	"

III.

Wheat bran,	3.00	lbs.
Old-process linseed meal,	3.00	"
Corn and cob meal,	3.00	"
Corn fodder,	9.00	"
Nutritive ratio,	1:4.93	
Total cost,	12.45	cts.
Manurial value obtainable,	7.65	"
Net cost,	4.80	"

Daily Fodder Rations used — Concluded.

IV.

Wheat bran,	3.00	lbs.
Old-process linseed meal,	3.00	"
Corn and cob meal,	3.00	"
Corn stover,	6.00	"
Nutritive ratio,	1:4.55	
Total cost,	10.58	cts.
Manurial value obtainable,	6.92	"
Net cost,	3.66	"

V.

Wheat bran,	3.00	lbs.
Old-process linseed meal,	3.00	"
Corn and cob meal,	3.00	"
Corn stover,	3.60	"
Sugar beets,	20.00	"
Nutritive ratio,	1:4.49	
Total cost,	14.98	cts.
Manurial value obtainable,	7.44	"
Net cost,	7.54	"

VI.

Wheat bran,	2.25	lbs.
Gluten meal,	2.25	"
Corn stover,	12.00	"
Nutritive ratio,	1:5.51	
Total cost,	7.45	cts.
Manurial value obtainable,	5.68	"
Net cost,	1.77	"

Steer 1 (Yearling).

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.								Total Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Corn and Cob Meal.	Corn Stover.	Corn Ensilage.	Corn Fodder.	Sugar Beets.					
1889-90.													
Dec. 17 to Dec. 31, . . .	2.27	2.33	–	–	5.27	–	–	–	7.82	1:4.63	675	654	-1.40
Jan. 4 to Jan. 22, . . .	3.88	3.88	–	–	–	37.89	–	–	16.72	1:5.51	667	708	2.16
Jan. 28 to Feb. 16, . . .	4.00	–	4.00	–	–	42.20	–	–	19.30	1:5.63	725	783	2.90
Feb. 21 to March 11, . . .	3.00	–	3.00	3.00	–	–	9.42	–	15.68	1:4.98	785	820	1.84
March 14 to April 21, . . .	3.00	–	3.00	3.00	5.91	–	–	–	12.50	1:4.54	828	880	1.33
April 24 to May 9, . . .	3.00	–	3.00	3.00	3.50	–	–	20.00	12.74	1:4.47	882	895	0.81

Total Amount of Feed consumed from Dec. 17, 1889, to May 9, 1890.

	Dry Matter (Pounds).	Cost.	Manurial Value.
465.50 pounds wheat bran, . . .	422.35	$3 84	$3 17
95.50 pounds gluten meal, . . .	86.14	1 10	0 77
371.00 pounds old-process linseed meal,	334.35	5 10	3 92
239.00 pounds corn and cob meal, .	219.64	1 97	0 72
243.50 pounds corn stover, . . .	177.88	0 61	0 57
1,927.00 pounds corn ensilage, . .	521.25	2 65	1 50
205.50 pounds corn fodder, . . .	163.54	0 77	0 50
350.00 pounds sugar beets, . . .	34.93	0 88	0 20
	1,960.08	$16 92	$11 35

	Pounds.
Live weight of animal at beginning of experiment, ...	675.00
Live weight of animal at end of feeding, ...	895.00
Live weight gained during experiment, ...	220.00
Average gain in weight per day, ...	1.53
Dry matter consumed per pound of live weight gained, . .	8.91
Cost of feed per pound of live weight gained, ...	7.69 cents.
Net cost of feed per pound of live weight gained, allowing 8 per cent. loss of manurial value, ...	2.95 cents.

Steer 2 (Yearling).

FEEDING PERIODS	Feed consumed (Pounds) per Day.								Total Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Corn and Cob Meal.	Corn Stover.	Corn Ensilage.	Corn Fodder.	Sugar Beets.					
1889-90.													
Dec. 17 to Dec. 31, . . .	2.00	2.07	–	–	5.27	–	–	–	6.53	1 : 4.76	600	590	-0.67
Jan. 4 to Jan. 22, . . .	3.88	3.88	–	–	–	37.32	–	–	16.54	1 : 5.47	610	674	3.37
Jan. 28 to Feb. 16, . . .	4.00	–	4.00	–	–	44.55	–	–	19.97	1 : 5.75	680	745	3.25
Feb. 21 to March 11, . . .	3.00	–	3.00	3.00	–	–	8.53	–	14.97	1 : 4.87	746	770	1.26
March 14 to April 21, . . .	3.00	–	3.00	3.00	6.00	–	–	–	12.56	1 : 4.55	776	826	1.28
April 24 to May 9, . . .	3.00	–	3.00	3.00	3.69	–	–	20.00	12.88	1 : 4.50	828	840	0.75

Total Amount of Feed consumed from Dec. 17, 1889, to May 9, 1890.

	Dry Matter (Pounds).	Cost.	Manurial Value.
465.50 pounds wheat bran,	422.35	$3 84	$3 17
95.50 pounds gluten meal,	86.14	1 10	0 77
371.00 pounds old-process linseed meal,	334.35	5 10	3 92
239.00 pounds corn and cob meal,	219.64	1 97	0 72
354.00 pounds corn stover,	258.60	0 89	0 83
1,942.00 pounds corn ensilage,	525.31	2 67	1 51
285.00 pounds corn fodder,	226.80	1 07	0 70
350.00 pounds sugar beets,	34.93	0 88	0 20
	2,108.12	$17 52	$11 82

	Pounds.
Live weight of animal at beginning of experiment,	600.00
Live weight of animal at end of feeding,	840.00
Live weight gained during experiment,	240.00
Average gain in weight per day,	1.67
Dry matter consumed per pound of live weight gained,	8.78
Cost of feed per pound of live weight gained,	7.30 cents.
Net cost of feed per pound of live weight gained, allowing 8 per cent. loss of manurial value,	2.77 cents.

Summary of Feeding Experiment with Steers One Year Old.

	No. 1.	No. 2.
Beginning of feeding experiment,	Dec. 17, 1889.	Dec. 17, 1889.
Close of feeding experiment,	May 9, 1890.	May 9, 1890.
Number of days of observation,	144	144
Live weight of animals at the beginning of observation,	675 lbs.	600 lbs.
Live weight of animals at the close of observation,	895 "	840 "
Total number of pounds of live weight gained during the experiment,	220 "	240 "
Average gain in live weight per day,	1.53 "	1.67 "
Amount of dry vegetable matter consumed per pound of live weight gained,	8.91 "	8.78 "
Total cost of feed consumed per day,	11.75 cts.	12.16 cts.
Manurial value of feed consumed per day,	7.87 "	8.20 "
Manurial value of feed consumed, allowing 8 per cent. loss,	7.24 "	7.54 "
Net cost of feed consumed per day, allowing a loss of 8 per cent. of manurial value for live weight gained,	4.51 "	4.62 "
Net cost of feed per pound of live weight gained,	2.95 "	2.77 "

Summary of Record of Steers No. 1 and No. 2, when left in the Pasture, May 10, 1889, to Sept. 30, 1889.

	No. 1.	No. 2.
Date of turning steers into pasture,	May 10, 1889.	May 10, 1889.
Date of closing pasturing,	Sept. 30, 1889.	Sept. 30, 1889.
Number of days of pasturing,	144	144
Live weight of steers when turned into pasture,	895 lbs.	840 lbs.
Live weight of steers at the close of pasturing,	1,020 "	923 "
Total weight gained during pasturing,	125 "	83 "
Average gain in weight per day,	0.87 "	0.58 "
Cost of feed per day, allowing 40 cents per week for use of pasture,	5.71 cts.	5.71 cts.
Cost of feed per pound of live weight gained,	6.58 "	9.91 "

Two-year Old Grade Shorthorn Steers.

[The same fodder articles as in the case of the one-year old steers served here.]

Daily Fodder Rations Used.

I.

Wheat bran,	3.88	lbs.
Gluten meal,	3.88	"
Corn ensilage,	65.50	"
Nutritive ratio,	1:6.54	
Total cost,	16.67	cts.
Manurial value obtainable,	10.02	"
Net cost,	6.65	"

II.

Wheat bran,	4.00	lbs.
Old-process linseed meal,	4.00	"
Corn ensilage,	76.60	"
Nutritive ratio,	1:6.75	
Total cost,	19.33	cts.
Manurial value obtainable,	11.89	"
Net cost,	7.44	"

III.

Wheat bran,	4.00	lbs.
Old-process linseed meal,	4.00	"
Corn and cob meal,	4.00	"
Corn fodder,	12.35	"
Nutritive ratio,	1:4.91	
Total cost,	16.73	cts.
Manurial value obtainable,	10.28	"
Net cost,	6.45	"

IV.

Wheat bran,	4.00	lbs.
Old-process linseed meal,	4.00	"
Corn and cob meal,	4.00	"
Corn stover,	13.00	"
Nutritive ratio,	1:4.99	
Total cost,	15.35	cts.
Manurial value obtainable,	10.30	"
Net cost,	5.05	"

V.

Wheat bran,	2.65	lbs.
Gluten meal,	2.65	"
Corn stover,	18.00	"
Nutritive ratio,	1:5.84	
Total cost,	9.74	cts.
Manurial value obtainable,	7.51	"
Net cost,	2.23	"

Steer No. 3.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.							Total Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Corn and Cob Meal.	Corn Stover.	Corn Ensilage.	Corn Fodder.					
1889-90.												
Dec. 10 to Dec. 31, ...	2.64	2.68	–	–	9.00	–	–	11.39	1 : 5.15	1,235	1,192	-1.95
Jan. 4 to Jan. 22, ...	3.88	3.88	–	–	–	68.95	–	24.60	1 : 6.64	1,210	1,297	4.58
Jan. 28 to Feb. 16, ...	4.00	4.00	–	–	–	80.10	–	30.13	1 : 6.89	1,310	1,362	2.60
Feb. 21 to March 11, ...	4.00	–	4.00	4.00	–	–	14.00	22.05	1 : 5.11	1,362	1,366	0.21
March 13 to March 25, ...	4.00	–	4.00	4.00	14.67	–	–	21.63	1 : 5.09	1,367	1,370	0.23

Total Amount of Feed consumed from Dec. 10, 1889, to March 25, 1890.

	Dry Matter (Pounds).	Cost.	Manurial Value.
387.50 pounds wheat bran, . . .	351.58	$3 20	$2 64
140.50 pounds gluten meal, . . .	126.73	1 62	1 14
248.00 pounds old-process linseed meal,	223.50	3 41	2 62
135.00 pounds corn and cob meal, .	124.07	1 11	0 41
392.00 pounds corn stover, . . .	286.36	0 98	0 92
3,542.00 pounds corn ensilage, . .	958.11	4 87	2 76
315.00 pounds corn fodder, . . .	250.68	1 18	0 77
	2,321.03	$16 37	$11 26

	Pounds.
Live weight of animal at beginning of experiment, . .	1,235.00
Live weight at time of killing, ...	1,370.00
Live weight gained during experiment, ...	135.00
Average gain in weight per day, ...	1.27
Dressed weight of animal, ...	886.00
Loss in weight by dressing, . .	484 pounds, or 35.33 per cent.
Original cost of animal, 1,336 pounds, at $3\frac{1}{2}$ cents, . . .	$46 76
Selling price of animal, 886 pounds, at 6 cents, . . .	53 16
Net cost of feed after deducting 8 per cent. of manurial value,	6 01
Dry matter required to produce 1 pound of live weight, .	17.19 pounds.
Cost of feed per pound gained, ...	12.13 cents.
Net cost of feed per pound gained after deducting 8 per cent of manurial value, ...	4.45 cents

Steer No. 4.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.							Total Dry Matter consumed per Day (Pounds).	Nutritive Ratio.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day (Pounds).
	Wheat Bran.	Gluten Meal.	Old-process Linseed Meal.	Corn and Cob Meal.	Corn Stover.	Corn Ensilage.	Corn Fodder.					
1889-90.												
Dec. 10 to Dec. 31,	2.64	2.68	–	–	5.25	–	–	8.65	1:4.45	1,180	1,138	–1.91
Jan. 4 to Jan. 22,	3.88	3.88	–	–	–	62.21	–	20.92	1:6.43	1,162	1,250	4.63
Jan. 28 to Feb. 16,	4.00	4.00	–	–	–	73.10	–	28.13	1:6.70	1,246	1,317	3.55
Feb. 21 to March 11,	4.00	–	4.00	4.00	–	–	10.71	19.43	1:4.81	1,305	1,293	–0.63
March 13 to March 25,	4.00	–	4.00	4.00	11.25	–	–	19.63	1:4.89	1,297	1,300	0.23

Total Amount of Feed consumed from Dec. 10, 1889, to March 25, 1890.

	Dry Matter (Pounds).	Cost.	Manurial Value.
387.50 pounds wheat bran,	351.58	$3 20	$2 64
140.50 pounds gluten meal,	126.73	1 62	1 14
248.00 pounds old-process linseed meal,	223.50	3 41	2 62
135.00 pounds corn and cob meal,	124.07	1 11	0 41
267.00 pounds corn stover,	195.04	0 67	0 63
3,210.50 pounds corn ensilage,	868.44	4 41	2 50
238.00 pounds corn fodder,	189.40	0 89	0 46
	2,078.76	$15 31	$10 40

	Pounds.
Live weight of animal at beginning of experiment,	1,180.00
Live weight at time of killing,	1,300.00
Live weight gained during experiment,	120.00
Average gain in weight per day,	1.13
Dressed weight of animal,	859.00
Loss in weight by dressing,	441 pounds, or 33.92 per cent.
Original cost of animal, 1,332 pounds, at 3½ cents,	$46 62
Selling price of steer, 859 pounds, at 6 cents,	51 54
Net cost of feed after deducting 8 per cent. of manurial value,	5 74
Dry matter required to produce 1 pound of live weight,	17.32 pounds.
Cost of feed per pound gained,	12.76 cents.
Net cost of feed per pound gained, after deducting 8 per cent. of manurial value,	4.78 cents.

Summary of Feeding Experiments, Steers Two Years Old, Nos. 3 and 4.

	No. 3.	No. 4.
Beginning of feeding experiment,	Dec. 10, 1889.	Dec. 10, 1889.
Close of observation,	Mar. 25, 1890.	Mar. 25, 1890.
Number of days of observation,	106	106
Live weight of animals at the beginning of observation,	1,235 lbs.	1,180 lbs.
Live weight of animals at close of observation,	1,370 "	1,300 "
Total number of pounds of live weight gained during experiment,	135 "	120 "
Average gain in live weight per day,	1.27 "	1.13 "
Amount of dry vegetable matter consumed per pound of live weight gained,	17.19 "	17.32 "
Total cost of feed consumed per day,	15.44 cts.	14.44 cts.
Manurial value of feed consumed per day,	10.62 "	9.82 "
Manurial value of feed consumed per day, allowing 8 per cent. loss,	9.77 "	9.03 "
Net cost of feed consumed per day, allowing a loss of 8 per cent. of manurial value,	5.67 "	5.41 "
Net cost of feed consumed per pound of live weight gained,	4.45 "	4.78 "
Selling price of dressed weight,	6.00 "	6.00 "
Per cent. of shrinkage in dressing beef for the market,	35.3	33.9

Analyses of Fodder Articles used in the Experiment.

Corn and Cob Meal.

1889-90.

	Per Cent
Moisture at 100° C.,	8.10
Dry matter,	91.90
	100.00

Analysis of Dry Matter.

Crude ash,	1.47
" cellulose,	5.63
" fat,	3.73
" protein (nitrogenous matter),	9.79
Non-nitrogenous extract matter,	79.38
	100.00
Passed screen, 144 meshes to square inch,	76.34

Wheat Bran (Average).

1889-1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.27	185.40	–	–	1 : 3.94
Dry matter,	90.73	1,814.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.47	149.40	–	–	
“ cellulose,	9.75	195.00	39.00	20	
“ fat,	5.48	109.60	87.68	80	
“ protein (nitrogenous matter),	17.53	350.60	308.53	88	
Non-nitrogenous extract matter,	59.77	1,195.40	956.32	80	
	100.00	2,000.00	1,391.53	–	

Gluten Meal.

1889-1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.80	196.00	–	–	1 : 2.60
Dry matter,	90.20	1,804.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.25	25.00	–	–	
“ cellulose,	1.75	35.00	11.90	34	
“ fat,	7.00	140.00	106.40	76	
“ protein (nitrogenous matter),	31.25	625.00	531.25	85	
Non-nitrogenous extract matter,	58.75	1,175.00	1,104.50	94	
	100.00	2,000.00	1,754.05	–	

Old-process Linseed Meal (Average).

1889-1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	9.88	197.60	–	–	1 : 1.70
Dry matter, ...	90.12	1,802.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	7.39	147.80	–	–	
" cellulose, . . .	8.74	174.80	45.45	26	
" fat, ...	7.24	144.80	131.77	91	
" protein (nitrogenous matter), . .	36.97	739.40	643.28	87	
Non-nitrogenous extract matter, ...	39.66	793.20	721.81	91	
	100.00	2,000.00	1,542.31	–	

Sugar Beets.

1889-1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	90.02	1,800.40	–	–	1 : 6.74
Dry matter, ...	9.98	199.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	11.84	236.80	–	–	
" cellulose, . . .	8.20	164.00	164.00	100	
" fat, ...	.71	14.20	14.20	100	
" protein (nitrogenous matter), . .	11.53	230.60	230.60	100	
Non-nitrogenous extract matter, ...	67.72	1,354.40	1,354.40	100	
	100.00	2,000.00	1,763.20	–	

Corn Ensilage (Average).

1889-1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	72.95	1,459.00	–	–	1 : 11.67
Dry matter,	27.05	541.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.48	129.60	–	–	
" cellulose,	26.33	526.60	379.15	72	
" fat,	5.17	103.40	77.55	75	
" protein (nitrogenous matter),	7.64	152.80	111.54	73	
Non-nitrogenous extract matter,	54.38	1,087.60	728.69	67	
	100.00	2,000.00	1,296.93	–	

Corn Fodder.

1889-1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	20.42	408.40	–	--	1 : 9.80
Dry matter,	79.58	1,591.60	–	--	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.40	148.00	–	–	
" cellulose,	20.11	402.20	289.58	72	
" fat,	1.65	33.00	24.75	75	
" protein (nitrogenous matter),	8.31	166.20	121.33	73	
Non-nitrogenous extract matter,	62.53	1,250.60	837.90	67	
	100.00	2,000.00	1,273.56	–	

Corn Stover.

[From Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	19.89
Dry matter,	80.11
	100.00

Analysis of Dry Matter.

Crude ash,	6.33
" cellulose,	34.59
" fat,	1.28
" protein (nitrogenous matter),	5.74
Non-nitrogenous extract matter,	52.06
	100.00

III.

FEEDING EXPERIMENTS WITH LAMBS.

SEPTEMBER 30, 1890, TO APRIL 20, 1891.

The feeding experiment with lambs described below is the second of a series devised to ascertain the influence of different fodder rations on the cost of feed when fattening lambs during the winter for the meat market.

The selection of animals was made from the temporary supply of our local market. Six lambs, wethers, grades of uncertain parentage, served for the trial; they were shorn before being weighed at the beginning of the observation. Each animal occupied a separate pen during the entire experiment. They received during the first week the same daily diet, and were subsequently divided into two lots of three each (lots A and B), to test the effect of different grain feed rations on the ultimate financial results of the operation.

1. *Weight of Lambs.*

		Original Live Weight of Lambs (Pounds).	Weight of Wool removed (Pounds).	Live Weight at the Beginning (Pounds).
LOT A.	1, ...	50.25	2.75	47.50
	2, ...	64.00	3.50	60.50
	3, ...	62.50	4.50	58.00
		176.75	10.75	166.00
LOT B.	4, ...	52.25	2.75	49.50
	5, ...	63.75	1.75	62.00
	6, ...	52.00	1.50	50.50
		168.00	6.00	162.00

2. *Cost of Lambs.*

The entire lot was bought at 5 cents per pound of live weight, and the sum paid for the entire original live weight of 344.75 pounds amounted to $17.24.

The wool subsequently secured before the beginning of the feeding experiment was sold at 25 cents per pound, or $4.19 for 16.75 pounds of wool.

Deducting the sum of $4.19 obtained for the wool removed from the first cost of the lambs, which was $17.24, it will be noticed that their actual cost was but $13.05, or 3.98 cents per pound of live weight. Their live weight after the removal of the wool amounted to 328 pounds.

Lot A.	1.	47.50 pounds, at 3.98 cents,	$1 89	$6 61
	2.	60.50 pounds, at 3.98 cents,	2 41	
	3.	58.00 pounds, at 3.98 cents,	2 31	
Lot B.	4.	49.50 pounds, at 3.98 cents,	$1 97	$6 44
	5.	62.00 pounds, at 3.98 cents,	2 46	
	6.	50.50 pounds, at 3.98 cents,	2 01	

3. *Character and Cost of Fodder Articles used.*

The grain feed rations of the daily diet contained, at different times and in varying proportions, corn meal, wheat bran, old-process linseed meal and Chicago gluten meal; while rowen — hay of second cut of upland meadows — and corn ensilage furnished its coarse feed constituent. The corn ensilage was produced from a dent corn variety, Pride of the North, which was cut when the kernels began to glaze.

The grain feed stuffs were bought in our local market; they were fair articles of their kind. Their relative composition and general economical value will be seen from the subsequent statements.

ANALYSES OF FODDER ARTICLES USED.	Corn Meal.	Wheat Bran.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn Ensilage.
Moisture at 100° C.,	13.26	12.11	8.72	10.90	13.90	80.53
Dry matter,	86.74	87.89	91.29	89.10	86.10	19.47
	100.00	100.00	100.00	100.00	100.00	100.00
Analysis of Dry Matter.						
Crude ash,	1.72	7.40	5.96	1.02	8.28	6.73
" cellulose,	2.28	12.17	8.23	1.28	28.88	26.90
" fat,	4.90	5.04	9.87	7.36	3.91	3.27
" protein (nitrogenous matter),	12.94	18.48	36.19	34.79	13.45	8.97
Non-nitrogenous extract matter,	78.16	56.91	39.75	55.55	45.48	54.13
	100.00	100.00	100.00	100.00	100.00	100.00

Fertilizing constituents of the above fodder articles: Nitrogen, 15 cents; phosphoric acid, 5½ cents; potassium oxide, 4½ cents per pound.

Moisture,	13.26	12.11	8.72	10.90	13.90	80.53
Nitrogen,	1.796	2.599	5.285	4.959	1.853	.279
Phosphoric acid,	.707	2.845	1.780	.425	.464	.101
Potassium oxide,	.435	1.625	1.214	.045	1.966	.226
Valuation per 2,000 pounds,	$6 56	$12 39	$18 90	$15 38	$7 84	$1 15

Local Market Value per Ton of the Various Articles of Fodder used (1890–1891).

Corn meal,	$28 00
Wheat bran,	25 00
Old-process linseed meal,	26 00
Gluten meal,	28 00
Rowen,	15 00
Corn ensilage,	2 75

4. *Mode of Feeding.*

The time occupied by the experiment amounted to two hundred and two days; it was divided into four feeding periods. The first feeding period extended over fourteen days, the second lasted ninety-eight days, the third thirty-four days and the fourth forty-one days. Eight days were usually allowed to pass by between succeeding feeding periods before the results accompanying the changes made in the diet were recorded. Each animal was kept in a separate pen; all received during the first period the same daily diet. This course was adopted to give each a fair chance in feed, and to bring all animals as far as practicable into a desirable uniform condition for a subsequent comparative test regarding the merits and good economy of different grain feed rations for meat production. They received their feed twice a day. At the close of the first feeding period a division of the lambs into two lots, A and B, each numbering three, was made for the purpose of *testing different grain feed rations in connection with the same article of coarse feed.*

The daily grain feed ration during *the first feeding period* consisted of a mixture of two weight parts of wheat bran and one weight part of old-process linseed meal. Eight ounces of this mixture were fed, per head, for every pound of rowen consumed. The amount of the grain feed mixture consumed daily per head varied from twelve to fourteen ounces, and that of rowen from one and one-half pounds to one and three-quarters pounds in case of different animals. *Subsequently two different combinations of grain feed were fed to the two lots of lambs* (A and B).

The daily grain feed ration in case of Lot A (1, 2 and 3) consisted of a mixture of ten weight parts of corn meal, two weight parts of wheat bran and one weight part of Chicago gluten meal. Lot B (4, 5 and 6) received as daily grain feed ration, during the same time, a mixture of two weight parts of wheat bran and one weight part of Chicago gluten meal.

Rowen and rowen with corn ensilage furnished alternately for both lots at corresponding periods the coarse feed portion of their daily diet. *Both lots of lambs received as their daily diet eight ounces of their respective grain feed mixture* in connection with *one pound of rowen* or *one-third of one pound of rowen, with all the corn ensilage they would consume* ($2\frac{3}{4}$ to 3 pounds). The daily diet of both lots differed essentially in regard to the relative proportion of digestible nitrogenous and non-nitrogenous food constituents they contained.

The fodder rations fed to lambs 1, 2, 3 were *less rich* in nitrogenous constituents (1 : 6.50 to 1 : 7.40) than those fed to lambs 4, 5, 6 (1 : 4.50 to 1 : 5.00). The subsequent statement contains the average composition of the daily fodder ration (per head) during the succeeding periods. Twenty per cent. of the phosphoric acid, potassium oxide and nitrogen contained in the feed consumed has been allowed as stored up in the increased live weight of the animal, and otherwise lost to the manurial refuse.

Average Daily Fodder Rations used for Lambs Nos. 1, 2 and 3.

I.

Wheat bran,	0.50	lbs.
Old-process linseed meal,	0.25	"
Rowen,	1.40	"
Nutritive ratio,	1:4.32	
Total cost,	2.00	cts.
Net cost,	0.99	"
Manurial value obtainable,	1.01	"

II.

Corn meal,	0.60	lbs.
Wheat bran,	0.12	"
Gluten meal,	0.06	"
Rowen,	1.35	"
Nutritive ratio,	1:6.51	
Total cost,	2.08	cts.
Net cost,	1.30	"
Manurial value obtainable,	0.78	"

III.

Corn meal,	0.60	lbs.
Wheat bran,	0.12	"
Gluten meal,	0.06	"
Rowen,	0.38	"
Corn ensilage,	3.56	"
Nutritive ratio,	1:7.40	
Total cost,	1.85	cts.
Net cost,	1.23	"
Manurial value obtainable,	0.62	"

Average Daily Fodder Rations, etc. — Concluded.

IV.

Corn meal,	0.73 lbs.
Wheat bran,	0.15 “
Gluten meal,	0.07 “
Rowen,	1.64 “
Nutritive ratio,	1:6.50
Total cost,	2.53 cts.
Net cost,	2.14 “
Manurial value obtainable,	0.39 “

Average Daily Fodder Rations used for Lambs Nos. 4, 5 and 6.

I.

Wheat bran,	0.53 lbs.
Old-process linseed meal,	0.27 “
Rowen,	1.42 “
Nutritive ratio,	1:4.27
Total cost,	2.08 cts.
Net cost,	1.02 “
Manurial value obtainable,	1.06 “

II.

Wheat bran,	0.56 lbs.
Gluten meal,	0.28 “
Rowen,	1.48 “
Nutritive ratio,	1:4.55
Total cost,	2.20 cts
Net cost,	1.14 “
Manurial value obtainable,	1.06 “

III.

Wheat bran,	0.48 lbs.
Gluten meal,	0.24 “
Rowen,	0.38 “
Corn ensilage,	3.33 “
Nutritive ratio,	1:5.01
Total cost,	1.69 cts.
Net cost,	0.94 “
Manurial value obtainable,	0.75 “

IV.

Wheat bran,	0.60 lbs.
Gluten meal,	0.30 “
Rowen,	1.34 “
Nutritive ratio,	1:4.51
Total cost,	2.17 cts.
Net cost,	1.13 “
Manurial value obtainable,	1.04 “

Summary of Cost of Above-stated Fodder Rations.

A.—Lambs 1, 2 and 3.

FEEDING PERIODS.	I. Cents.	II. Cents.	III. Cents.	IV. Cents.
Total cost of feed consumed,	2.00	2.08	1.85	2.53
Manurial value obtainable (80 per cent.),	1.01	0.78	0.62	0.39
Net cost of feed,	0.99	1.30	1.23	2.14

B.—Lambs 4, 5 and 6.

FEEDING PERIODS.	I. Cents.	II. Cents.	III. Cents.	IV. Cents.
Total cost of feed consumed,	2.08	2.20	1.69	2.17
Manurial value obtainable (80 per cent.),	1.06	1.06	0.75	1.04
Net cost of feed,	1.02	1.14	0.94	1.13

5. *Gain in Live Weight during Experiment.*

Lot A.

	Live Weight at the Beginning of Experiment (Pounds).	Live Weight at Close of Experiment (Pounds).	Gain in Live Weight during Experiment (Pounds).
1,	47.50	93.50	46.00
2,	60.50	98.75	38.25
3,	58.00	109.75	51.75
Average,	55.33	100.67	45.33

Lot B.

	Live Weight at the Beginning of Experiment (Pounds).	Live Weight at Close of Experiment (Pounds).	Gain in Live Weight during Experiment (Pounds).
4,	49.50	81.25	31.75
5,	62.00	101.25	39.25
6,	50.00	103.00	53.00
Average,	53.83	95.17	41.33

Lot A gained in live weight per head, on an average, 0.224 pounds.

Lot B gained in live weight per head, on an average, 0.205 pounds.

Amount of Raw Wool secured after the Close of the Experiment.

Lot A.

	Live Weight with Wool (Pounds).	Live Weight after Shearing (Pounds).	Amount of Wool obtained (Pounds).
1,	93.50	89.00	4.50
2,	98.75	93.25	5.50
3,	109.75	104.00	5.75
	302.00	286.25	15.75

Lot B.

	Live Weight with Wool (Pounds).	Live Weight after Shearing (Pounds).	Amount of Wool obtained (Pounds).
4,	81.25	76.00	5.25
5,	101.25	97.00	4.25
6,	103.00	97.75	5.25
	285.50	270.75	14.75

6. *Financial Statement.*

The wool was sold at 25 cents per pound and the pelt at 12.5 cents. The difference between the live weights of the animals 1, 2 and 3 at the close of the experiment, and their dressed weights, varied from 49 per cent. to 52 per cent., and averaged per head 51.2 per cent.; in case of animals 4, 5 and 6 it varied from 45 per cent. to 52 per cent., and averaged per head 48.6 per cent.

Yield of Dressed Weight.

1.	47.00 pounds, at 11 cents,	$5 17
2.	48.00 pounds, at 11 cents,	5 28
3.	52.25 pounds, at 11 cents,	5 75
	147.25 pounds,	$16 20
4.	42.00 pounds, at 11 cents,	$4 62
5.	55.50 pounds, at 11 cents,	6 11
6.	49.00 pounds, at 11 cents,	5 39
	146.50 pounds,	$16 12

Yield of Dressed Weight — Concluded.

Lot A.

	1.	2.	3.	Total.
Cost of lambs,	$1 89	$2 41	$2 31	$20 58
Cost of feed consumed,	4 30	4 46	5 21	
	$6 19	$6 87	$7 52	
Value received for meat,	$5 17	$5 28	$5 75	$25 07
Value received for wool and pelt,	1 25	1 50	1 56	
Value of obtainable manure,	1 41	1 46	1 69	
	$7 83	$8 24	$9 00	

Lot B.

	4.	5.	6.	Total.
Cost of lambs,	$1 97	$2 46	$2 01	$20 86
Cost of feed consumed,	3 49	5 26	5 67	
	$5 46	$7 72	$7 68	
Value received for meat,	$4 62	$6 11	$5 39	$26 14
Value received for wool and pelt,	1 44	1 19	1 44	
Value of obtainable manure,	1 44	2 17	2 34	
	$7 50	$9 47	$9 17	

Market Cost of Fodder Articles for 1890–91, as compared with 1889–90.

	1889-90.	1890-91.
	Per Ton.	Per Ton.
Corn meal,	$19 00	$28 00
Wheat bran,	17 00	25 00
Old-process linseed meal,	27 00	26 00
Gluten meal,	23 00	28 00
Corn ensilage,	2 75	2 75
Rowen,	15 00	15 00

Total Cost of Feed consumed, counted on Basis of 1889–90 and of 1890–91.

	1889-90.	1890-91.
Sheep 1,	$3 61	$4 30
Sheep 2,	3 74	4 46
Sheep 3,	4 38	5 21
Sheep 4,	3 00	3 49
Sheep 5,	4 54	5 26
Sheep 6,	4 93	5 67
	$24 20	$28 39

Conclusions.

1. The increase in live weight during the first feeding period is, in four out of six cases, lower than in any other period, and affects seriously the financial results of the whole experiment.

2. The total increase per head in live weight per day averages for the entire time of the experiment .23 pounds for Lot A (1, 2 and 3), and .22 pounds for Lot B (4, 5 and 6). In one case it amounts to .39 pounds per day (Lot A, 2, Period IV.); in nine cases it rises above .25 pounds.

3. The market cost of the daily individual fodder rations varies in different feeding periods from 1.69 cents to 2.53 cents. The rations that contain from three to four pounds of corn ensilage, in place of three-fourths of the rowen of other rations, furnish the cheapest daily diet (Period III., Lot A, 1.85 cents, and Lot B, 1.69 cents).

4. The market cost of the feed consumed during the experiment by the lambs of Lot A amounts per head to $4.66, and in case of Lot B to $4.81, — a difference of 15 cents. The three lambs of Lot A cost $6.62, those of Lot B cost $6.47; making cost of lambs and of the feed consumed $20.58 in case of the former, and $20.86 in case of the latter.

5. Dressed lambs, wool and pelts, brought, in case of Lot A, $20.51, and in case of Lot B, $20.19.

6. The obtainable manurial value of the feed consumed by the lambs of Lot A averages per head $1.52, or one-third of the market cost of the feed, and amounts to $1.95 per head, or two-fifths of the market cost of the feed consumed in case of the lambs of Lot B, — a difference of $0.45 per head in favor of the latter, or $4.56 for Lot A and $5.95 for Lot B, — a difference of $1.39 in favor of the latter.

7. The value of the obtainable manure, amounting from ten to eleven dollars for the entire operation, represents the profits of the experiment, aside from disposing of our home-raised fodder articles at a liberal retail market price.

8. The advance on the market cost of the concentrated commercial feed stuffs used in the experiment of 1890–91, as compared with that of 1889–90, amounts to $4.19 as far as the feed consumed is concerned, or 70 cents per head.

Sheep No. 1.

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.						Pounds of Dry Matter in Daily Fodder consumed.	Gain in Live Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound of Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Corn Meal.	Wheat Bran.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn Ensilage.					
1890-91.											
Sept. 30 to Oct. 13,	-	0.45	0.23	-	1.25	-	1.68	0.11	15.27	1:4.30	47.50
Oct. 14 to Jan. 19,	0.61	0.12	-	0.06	1.39	-	1.89	0.20	9.45	1:6.50	60.00
Jan. 27 to March 2,	0.58	0.12	-	0.06	0.40	3.53	1.69	0.21	8.05	1:7.39	74.50
March 10 to April 20,	0.73	0.15	-	0.07	1.63	-	2.22	0.33	6.73	1:6.51	86.50

Total Amount of Feed consumed from Sept. 30, 1890, to April 20, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
118.27 pounds corn meal, ...	102.59	$1 66	$0 39
29.98 pounds wheat bran, ...	26.35	0 37	0 19
3.17 pounds old-process linseed meal, .	2.89	0 04	0 03
11.83 pounds gluten meal, ...	10.54	0 17	0 09
247.25 pounds rowen, ...	212.88	1 85	0 97
155.00 pounds corn ensilage, ...	30.18	0 21	0 09
	385.43	$4 30	$1 76

	Pounds.
Live weight of animal at beginning of experiment, ...	47.50
Live weight at time of killing, ...	93.50
Live weight gained during experiment, ...	46.00
Average gain in weight per day, ...	0.23
Dressed weight of animal, ...	47.00
Loss in weight by dressing, . . .	46.5 pounds, or 49.73 per cent.
Pounds of dry matter fed produced 1 pound of live weight, .	8.38
Cost of feed per pound of live weight gained, ...	9.35 cents.
Net cost of feed per pound gained after deducting 8 per cent. of manurial value, ...	5.83 cents.

Sheep No. 2.

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.						Pounds of Dry Matter in Daily Fodder consumed.	Gain in Live Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound of Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Corn Meal.	Wheat Bran.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn Ensilage.					
1890-91.											
Sept. 30 to Oct. 13,	–	0.53	0.27	–	1.46	–	1.97	0.07	28.14	1:4.30	60.50
Oct. 14 to Jan. 19,	0.60	0.12	–	0.06	1.33	–	1.83	0.13	14.08	1:6.51	69.00
Jan. 27 to March 2,	0.63	0.13	–	0.06	0.50	3.80	1.88	0.28	6.71	1:7.38	80.00
March 10 to April 20,	0.75	0.15	–	0.08	1.73	–	2.34	0.39	6.00	1:6.50	92.50

Total Amount of Feed consumed from Sept. 30, 1890, to April 20, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
121.73 pounds corn meal,	105.59	$1 70	$0 40
31.75 pounds wheat bran,	27.91	0 40	0 20
3.70 pounds old-process linseed meal,	3.38	0 05	0 03
12.17 pounds gluten meal,	10.84	0 17	0 09
254.00 pounds rowen,	218.69	1 91	1 00
169.50 pounds corn ensilage,	33.00	0 23	0 10
	399.41	$4 46	$1 82

	Pounds.
Live weight of animal at beginning of experiment,	60.50
Live weight at time of killing,	98.75
Live weight gained during experiment,	38.25
Average gain in weight per day,	0.19
Dressed weight of animal,	48.00
Loss in weight by dressing,	50.75 pounds, or 51.39 per cent.
Pounds of dry matter fed produced 1 pound of live weight,	10.44
Cost of feed per pound of live weight gained,	11.66 cents.
Net cost of feed per pound gained after deducting 8 per cent. of manurial value,	7.29 cents.

Sheep No. 3.

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.						Pounds of Dry Matter in Daily Fodder consumed.	Gain in Live Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound of Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Corn Meal.	Wheat Bran.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn Ensilage.					
1890-91.											
Sept. 30 to Oct. 13,	–	0.53	0.27	–	1.50	–	2.00	0.27	7.41	1:4.36	59.75
Oct. 14 to Jan. 19,	0.69	0.14	–	0.07	1.63	–	2.18	0.24	9.08	1:6.50	72.00
Jan. 27 to March 2,	0.75	0.15	–	0.08	0.50	4.91	2.24	0.24	9.31	1:7.43	90.75
March 10 to April 20,	0.90	0.18	–	0.09	2.05	–	2.79	0.27	13.33	1:6.50	104.75

Total Amount of Feed consumed from Sept. 30, 1890, to April 20, 1891.

	Dry Matter (Pounds)	Cost.	Manurial Value.
141.54 pounds corn meal, ...	122.77	$1 98	$0 46
35.71 pounds wheat bran, ...	31.39	0 45	0 22
3.70 pounds old-process linseed meal, .	3.38	0 05	0 03
14.15 pounds gluten meal, ...	12.61	0 20	0 11
299.25 pounds rowen, ...	256.66	2 24	1 17
209.50 pounds corn ensilage, ...	40.79	0 29	0 12
	467.60	$5 21	$2 11

	Pounds.
Live weight of animal at beginning of experiment, ...	58.00
Live weight at time of killing, ...	109.75
Live weight gained during experiment, ...	51.75
Average gain in weight per day, ...	0.25
Dressed weight of animal, ...	52.25
Loss in weight by dressing, . . . 57.50 pounds, or	52.39 per cent.
Pounds of dry matter fed produced 1 pound of live weight, .	9.04
Cost of feed per pound of live weight gained, ...	10.07 cents.
Net cost of feed per pound gained after deducting 8 per cent. of manurial value, ...	6.32 cents.

Sheep No. 4.

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.						Pounds of Dry Matter in Daily Fodder consumed.	Gain in Live Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound of Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Corn Meal.	Wheat Bran.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn Ensilage.					
1890-91.											
Sept. 30 to Oct. 13,	–	0.50	0.25	–	1.21	–	1.71	0.18	9.50	1:4.20	50.25
Oct. 14 to Jan. 19,	–	0.44	–	0.22	0.98	–	1.42	0.13	10.92	1:4.42	59.00
Jan. 27 to March 2,	–	0.42	–	0.21	0.41	3.00	1.48	0.21	7.05	1:5.09	68.25
March 10 to April 20,	–	0.57	–	0.28	1.42	–	1.98	0.26	7.62	1:4.51	78.25

Total Amount of Feed consumed from Sept. 30, 1890, to April 20, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
95.33 pounds wheat bran, ...	83.79	$1 19	$0 59
3.50 pounds old-process linseed meal, .	3.19	0 05	0 03
44.17 pounds gluten meal, . : .	39.36	0 62	0 34
193.25 pounds rowen, ...	166.39	1 45	0 76
130.50 pounds corn ensilage, . . .	25.41	0 18	0 08
	318.14	$3 49	$1 80

	Pounds.
Weight of animal at beginning of experiment, ...	49.50
Live weight at time of killing, ...	81.25
Live weight gained during experiment, ...	31.75
Average gain in weight per day, ...	0.16
Dressed weight of animal, ...	42.00
Loss in weight by dressing, . . 39.25 pounds, or 48.31 per cent.	
Pounds of dry matter fed produced 1 pound live weight, . .	10.02
Cost of feed per pound of live weight gained, . . .	10.99 cents.
Net cost of feed per pound gained after deducting 8 per cent. of manurial value, ...	5.76 cents.

Sheep No. 5.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.						Pounds of Dry Matter in Daily Fodder consumed.	Gain in Live Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound of Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Corn Meal.	Wheat Bran.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn Ensilage.					
1890-91.											
Sept. 30 to Oct. 13,	-	0.57	0.29	-	1.71	-	2.23	0.21	10.62	1:4.36	62.50
Oct. 14 to Jan. 19,	-	0.67	-	0.33	1.78	-	2.41	0.19	12.68	1:4.56	76.00
Jan. 27 to March 2,	-	0.65	-	0.33	0.43	4.76	2.16	0.29	7.45	1:5.02	90.50
March 10 to April 20,	-	0.72	-	0.36	1.87	-	2.56	8.24	10.66	1:4.53	100.25

Total Amount of Feed consumed from Sept. 30, 1890, to April 20, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
136.50 pounds wheat bran,	119.97	$1 71	$0 85
4.00 pounds old-process linseed meal,	3.65	0 05	0 04
64.25 pounds gluten meal,	57.25	0 91	0 49
308.50 pounds rowen,	265.62	2 31	1 21
202.00 pounds corn ensilage,	39.33	0 28	0 12
	485.82	$5 26	$2 71

	Pounds.
Live weight of animal at beginning of experiment,	62.00
Live weight at time of killing,	101.25
Live weight gained during experiment,	39.25
Average gain in weight per day,	0.19
Dressed weight of animal,	55.50
Loss in weight by dressing,	45.75 pounds, or 45.16 per cent.
Pounds of dry matter fed produced 1 pound of live weight,	12.38
Cost of feed per pound of live weight gained,	13.40 cents.
Net cost of feed per pound gained after deducting 8 per cent. of manurial value,	7.06 cents.

Sheep No. 6.

FEEDING PERIODS.	Feed consumed (Pounds) per Day.						Pounds of Dry Matter in Daily Fodder consumed.	Gain in Live Weight per Day (Pounds).	Pounds of Dry Matter produced One Pound of Live Weight.	Nutritive Ratio.	Average Weight of Animal (Pounds).
	Corn Meal.	Wheat Bran.	Old-process Linseed Meal.	Gluten Meal.	Rowen.	Corn Ensilage.					
1890-91.											
Sept. 30 to Oct. 13,	–	0.53	0.27	–	1.34	–	1.87	0.14	13.36	1:4.24	50.50
Oct. 14 to Jan. 19,	–	0.67	–	0.33	1.89	–	2.51	0.27	9.30	1:4.61	65.50
Jan. 27 to March 2,	–	0.67	–	0.33	0.50	5.23	2.33	0.29	8.03	1:5.15	84.00
March 10 to April 20,	–	0.87	–	0.43	2.50	–	3.29	0.27	12.19	1:4.62	96.25

Total Amount of Feed consumed from Sept. 30, 1890, to April 20, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
142.74 pounds wheat bran, ...	125.45	$1 78	$0 88
3.70 pounds old-process linseed meal, .	3.38	0 05	0 03
67.67 pounds gluten meal, ...	60.29	0 95	0 52
345.75 pounds rowen, ...	297.69	2 59	1 36
220.00 pounds corn ensilage, . . .	42.83	0 30	0 13
	529.64	$5 67	$2 92

	Pounds.
Live weight of animal at beginning of experiment, ...	50.00
Live weight at time of killing, ...	103.00
Live weight gained during experiment, ...	53.00
Average gain in weight per day, ...	0.26
Dressed weight of animal, ...	49.00
Loss in weight by dressing, . . . 54.00 pounds, or	52.43 per cent.
Pounds of dry matter fed produced 1 pound of live weight, .	9.99
Cost of feed per pound of live weight gained, ...	10.70 cents.
Net cost of feed per pound gained after deducting 8 per cent. of manurial value, ...	5.62 cents.

Fodder Articles used in the Experiment.

Corn Meal (Average).

1890-1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents	Nutritive Ratio.
Moisture at 100° C.,	13.26	265.20	–	–	1 : 8.62
Dry matter,	86.74	1,734.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.72	34.40	–	–	
" cellulose,	2.28	45.60	21.89	48	
" fat,	4.90	98.00	83.30	85	
" protein (nitrogenous matter),	12.94	258.80	204.45	79	
Non-nitrogenous extract matter,	78.16	1,563.20	1,531.94	98	
	100.00	2,000.00	1,841.58	–	

Wheat Bran (Average).

1890-1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.11	242.20	–	–	1 : 3.86
Dry matter,	87.89	1,757.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.40	148.00	–	–	
" cellulose,	12.17	243.40	58.42	24	
" fat,	5.04	100.80	71.57	71	
" protein (nitrogenous matter),	18.48	369.60	288.29	78	
Non-nitrogenous extract matter,	56.91	1,138.20	876.41	77	
	100.00	2,000.00	1,294.69	–	

Old-process Linseed Meal.

1890-1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	8.72	174.40	–	–	1:1.93
Dry matter, . . .	91.28	1,825.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, . . .	5.96	119.20	–	–	
" cellulose, . . .	8.23	164.60	42.79	26	
" fat, ...	9.87	197.40	179.63	91	
" protein (nitrogenous matter), . .	36.19	723.80	629.70	87	
Non-nitrogenous extract matter, ...	39.75	795.00	723.45	91	
	100.00	2,000.00	1,575.57	–	

Gluten Meal.

1890-1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	10.90	218.00	–	–	1:2.44
Dry matter, . . .	89.10	1,782.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.02	20.40	–	–	
" cellulose, . . .	1.28	25.60	15.87	62	
" fat, ...	7.36	147.20	125.12	85	
" protein (nitrogenous matter), . .	34.79	695.80	549.68	79	
Non-nitrogenous extract matter, ...	55.55	1,111.00	1,011.01	91	
	100.00	2,000.00	1,701.68	–	

Rowen (Average).

1890-1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.90	278.00	–	–	1 : 6.35
Dry matter,	86.10	1,722.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	8.28	165.60	–	–	
" cellulose,	28.88	577.60	369.66	64	
" fat,	3.91	78.20	35.97	46	
" protein (nitrogenous matter),	13.45	269.00	166.78	62	
Non-nitrogenous extract matter,	45.48	909.60	600.34	66	
	100.00	2,000.00	1,172.75	–	

Corn Ensilage.

1890-1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	80.53	1,610.60	–	–	1 : 9.26
Dry matter,	19.47	389.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.73	134.60	–	–	
" cellulose,	26.90	538.00	387.36	72	
" fat,	3.27	65.40	49.05	75	
" protein (nitrogenous matter),	8.97	179.40	134.55	75	
Non-nitrogenous extract matter,	54.13	1,082.60	736.17	68	
	100.00	2,000.00	1,307.13	–	

IV.

THREE FEEDING EXPERIMENTS WITH PIGS (THOROUGHBREDS).

1890-1891.

Breeds: Small Yorkshires, Berkshires, Poland Chinas, Tamworths.

Feed: Creamery buttermilk, home skim-milk, corn meal, wheat bran, gluten meal (Chicago variety).

The general management of these experiments was similar to that adopted in our late pig-feeding experiments with grades. From two to three animals of each breed served in our trial.

Three experiments were carried on in succession. The Small Yorkshires were kindly furnished by Messrs. Warren Heustis & Sons, Belmont, Mass.; Berkshires by Col. Henry L. Russell, Milton, Mass.; Poland Chinas by Mr. Smith Harding, South Deerfield, Mass.; Tamworths by Mr. Joshua M. Sears, Boston, Mass.

Weight of Animals at the Beginning of the Experiments.

I.	Small Yorkshires,	24 to 26 pounds.
	Berkshires,	26 to 36 pounds.
	Poland Chinas,	20 to 22 pounds.
	Tamworths,	21 to 24 pounds.
II.	Small Yorkshires,	42 to 52 pounds.
	Berkshires,	20 to 23 pounds.
	Poland Chinas,	42 to 50 pounds.
	Tamworths,	34 to 38 pounds.
III.	Small Yorkshires,	26 to 27 pounds.
	Berkshires,	23 to 26 pounds.
	Poland Chinas,	23.5 to 24 pounds
	Tamworths,	38 to 42 pounds.

Average Composition of Fodder Rations used during the Three Feeding Periods of Each Feeding Experiment.

Experiment I.

FEEDING PERIODS.	Corn Meal.	Wheat Bran.	Gluten Meal.	Skim-milk.	Buttermilk.
	Ounces.	Ounces.	Ounces.	Quarts.	Quarts.
I.,	10	3½	7	–	5
II.,	29½	9½	9½	–	5
III.,	57	13½	13½	5	–
Experiment II.					
I.,	6	6	12	3	–
II ,	22½	8½	8½	3½	–
III.,	35	5½	5½	4	–
Experiment III.					
I ,	11	6	12	5½	–
II.,	31½	11½	11½	5	–
III.,	52	11	11	5	–

The amount of milk used was controlled by our daily supply and by the number of pigs under observation. During the first experiment creamery buttermilk was fed during the two first feeding periods; during the remaining time home-made skim-milk alone was used. As a general rule during the entire experiment the following system was adopted for compounding the daily diet in different feeding periods : —

Period I. For each one quart skim-milk to two ounces of corn meal.

Period II. For each, one quart skim-milk to four ounces of corn meal.

Period III. For each, one quart skim-milk to six ounces of corn meal.

The daily quantity of this feed was governed by the appetite of each animal. Whenever the supply of either kind of milk, or of both kinds, was exhausted, the additional feed called for was prepared in the following manner: —

		Nutritive Ratio.
Period I.	Wheat bran, one weight part, ... Gluten meal, two weight parts, ...	1 : 2.80
Period II.	Corn meal, one weight part, ... Wheat bran, one weight part, ... Gluten meal, one weight part, ...	1 : 3.80
Period III.	Corn meal, two weight parts, ... Wheat bran, one weight part, ... Gluten meal, one weight part, ...	1 : 4.35

The entire management of the feeding was divided, as will be noticed, into three periods, as far as the nutritive character of the daily diet was concerned.

	Live Weight.	Nutritive Ratio.
Period I., ...	20 to 90 pounds, . .	1 : 2.80
Period II., ...	90 to 130 pounds, . .	1 : 3.80
Period III., ...	130 to 200 pounds,. .	1 : 4.35

During the summer season the feed was given twice a day; during the winter season, three times. Whenever the milk did not satisfy the thirst of the animals warm water was added to the grain to meet the temporary wants.

The results of the two first experiments, being more of an experimental character, are subsequently given in a brief abstract; the third experiment is reported also in regard to all details of a special interest. Those animals which for more than a few days refused to consume a fair share of their daily diet are excluded from the record, in common with a few losses soon after their arrival during our first and second experiment.

Summary of Experiment I. (May 13 to Oct. 15, 1890).

	Corn Meal (Pounds).	Buttermilk (Quarts).	Skim-milk (Quarts).	Wheat Bran (Pounds).	Gluten Meal (Pounds).	Live Weight gained during Experiment.	Dressed Weight gained during Experiment.	Cost per Pound of Dressed Pork (Cents).
Small Yorkshires, 2 pigs,	560.35	1,129.00	355.00	153.74	187.18	367.25	311.75	4.79
Poland China,	305.10	558.50	177.50	95.65	116.38	215.50	180.00	4.57
Berkshires, 3 pigs,	721.71	1,491.50	532.50	211.42	250.36	512.25	415.50	4.80
Tamworths, 2 pigs,	478.53	889.00	355.00	137.29	156.50	354.75	283.75	4.52

Local Market Cost of Fodder Articles used during Experiment I.

Corn meal, per ton,	$24 00
Wheat bran, per ton,	19 00
Gluten meal, per ton,	25 00
Buttermilk, per gallon,	1 cent.
Skim-milk, per gallon,	1 8 cents.

Valuation of essential fertilizing constituents in the above articles of fodder used: Nitrogen, 17 cents; phosphoric acid, 6 cents; potassium oxide, 4½ cents per pound.

	Corn Meal.	Wheat Bran.	Gluten Meal.	Butter-milk.	Skim-milk.
Moisture,	12.39	11.52	8.48	93.34	89.78
Nitrogen,	1.466	2.600	5.358	.391	.520
Phosphoric acid,	.707	2.870	.425	.135	.190
Potassium oxide,	.435	1.620	.045	.143	.200
Valuation per 2,000 pounds,	$6 22	$13 74	$19 13	$1 62	$2 18

Summary of Experiment II. (Nov. 18, 1890, to April 19, 1891).

	Corn Meal (Pounds).	Skim-milk (Quarts).	Wheat Bran (Pounds).	Gluten Meal (Pounds).	Live Weight gained during Experiment.	Dressed Weight gained during Experiment.	Cost per Pound of Dressed Pork (Cents).
Berkshire, No. 1,	159.54	511.00	43.80	60.49	136.50	112.77	5.19
Berkshire, No. 2,	149.08	511.00	35.65	50.46	129.50	105.14	5.20
Poland China, No. 1,	223.54	488.50	69.96	84.96	157.00	132.35	5.50
Poland China, No. 2,	170.68	491.00	48.94	63.75	114.00	95.73	6.28
Small Yorkshire, No. 1,	215.40	515.00	60.01	71.82	151.75	127.11	5.53
Small Yorkshire, No. 2,	218.84	515.00	63.70	82.26	146.00	123.56	5.84

Local Market Value of the Various Articles of Fodder used during Experiment II.

Corn meal, per ton,	$27 00
Skim-milk, per gallon,	1.8 cents.
Wheat bran, per ton,	$25 00
Gluten meal, per ton,	28 00

Valuation of essential fertilizing constituents of the above fodder articles: Nitrogen, 15 cents; phosphoric acid, 5½ cents; potassium oxide, 4½ cents per pound.

	Corn Meal.	Skim-milk.	Wheat Bran.	Gluten Meal.
Moisture,	13.26	89.78	12.11	10.90
Nitrogen,	1.796	.520	2.599	4.959
Phosphoric acid,	.707	.190	2.845	.425
Potassium oxide,	.435	.200	1.625	.045
Valuation per 2,000 pounds,	$6 56	$1 95	$12 39	$15 38

Summary of Experiment III. (May 12 to Sept. 7, 1891).

	Corn Meal (Pounds).	Skim-milk (Quarts).	Wheat Bran (Pounds).	Gluten Meal (Pounds).	Live Weight gained during Experiment.	Dressed Weight gained during Experiment.	Cost per Pound of Dressed Pork (Cents).
Berkshire, No. 1,	237.70	631.00	80.46	105.07	177.50	142.96	6.20
Berkshire, No. 2,	221.66	631.00	70.82	94.51	169.25	141.04	5.93
Small Yorkshire, No. 1,	215.60	680.00	53.45	67.93	156.00	126.86	6.25
Small Yorkshire, No. 2,	268.53	794.00	58.68	73.16	174.00	145.36	6.46
Poland China, No. 1,	208.44	589.00	59.29	75.16	171.50	136.61	5.54
Poland China, No. 2,	204.31	589.00	61.10	74.42	156.50	124.77	6.03
Tamworth, No. 1,	210.07	510.00	73.24	92.38	143.00	126.33	6.06
Tamworth, No. 2,	206.57	510.00	72.46	91.73	141.75	114.90	6.59

Local Market Value of the Various Articles of Fodder used during Experiment III.

Corn meal, per ton,	$31 00
Skim-milk, per gallon,	1.8 cents.
Wheat bran, per ton,	$23 00
Gluten meal, per ton,	27 00

Valuation of the essential fertilizing constituents of the above fodder articles: Nitrogen, 15 cents; phosphoric acid, 5½ cents; potassium oxide, 4½ cents per pound.

	Corn Meal.	Skim-milk.	Wheat Bran.	Gluten Meal.
Moisture,	15.31	91.18	12.99	11.11
Nitrogen,	1.651	.445	2.249	4.741
Phosphoric acid,	.693	.163	2.793	.413
Potassium oxide,	.426	.172	1.592	.044
Valuation per 2,000 pounds,	$6 10	$1 67	$11 25	$14 72

Summary of the Three Feeding Experiments, regarding the Character and Quantity of Feed consumed per Pound of Live Weight and Dressed Weight produced.

I. May to October, 1890.

BREED.	Number of Animals on Trial.	Nutritive Ratio, Period I.	Nutritive Ratio, Period II.	Nutritive Ratio, Period III.	Dry Matter consumed per Pound of Live Weight (Pounds).	Dry Matter consumed per Pound of Dressed Weight (Pounds).
Small Yorkshire, ...	2	1:2.79	1:3.90	1:4.49	2.82	3.32
Berkshire, ...	3	1:2.82	1:3.85	1:4.47	2.69	3.31
Poland China, ...	1	1:2.76	1:3.84	1:4.50	2.67	3.20
Tamworth, ...	2	1:2.85	1:3.85	1:4.48	2.50	3.13
II. November, 1890, to April, 1891.						
Small Yorkshire, ...	2	1:2.88	1:3.80	1:4.38	2.87	3.42
Berkshire, ...	2	1:2.89	1:3.76	1:4.35	2.49	3.04
Poland China, ...	1	1:2.85	1:3.74	1:4.39	2.80	3.32
Tamworth, ...	-	-	-	-	-	-
III. May to September, 1891.						
Small Yorkshire, ...	2	1:3.14	1:4.19	1:4.80	2.77	3.36
Berkshire, ...	2	1:3.13	1:4.22	1:4.89	2.71	3.31
Poland China, ...	2	1:3.14	1:4.23	1:4.90	2.49	3.12
Tamworth, ...	2	1:3.12	1:4.26	1:4.93	2.94	3.48

Summary of the Three Feeding Experiments, regarding Gain in Weight, Cost of Feed and Rate of Shrinkage of Pork dressed for the Market.

BREED.	Number of Animals on Trial.	Average Live Weight of Animals on Trial at Beginning.	Average Live Weight of Animals at Time of Killing.	Number of Days on Trial.	Average Gain in Live Weight during Experiment (Pounds).	Average Gain in Live Weight per Day (Pounds).	Average Cost of Feed per Pound of Dressed Pork (Cents).	Average Shrinkage in Weight by Dressing (Per Cent.).
I.								
Small Yorkshire, .	2	26.80	212.10	156	185.60	1.19	4.79	15.09
Berkshire, . .	3	21.50	192.00	142	170.70	1.20	4.80	18.87
Poland China, .	1	26.25	241.75	156	215.50	1.38	4.57	16.44
Tamworth, . .	2	22.75	199.90	128	177.00	1.38	4.52	20.01
II.								
Small Yorkshire, .	2	47.38	196.20	148	148.80	1.01	5.19	15.80
Berkshire, . .	2	21.12	154.12	148	133.0	0.90	4.80	18.01
Poland China, .	1	46.00	207.00	141	157.0	1.11	4.98	15.87
Tamworth, . .	-	-	-	-	-	-	-	-
III.								
Small Yorkshire, .	2	26.25	191.25	144.5	165.0	1.15	5.61	17.57
Berkshire, . .	2	24.12	197.50	128	173.4	1.35	5.32	18.06
Poland China, .	2	23.60	187.60	119	163.5	1.38	5.09	20.37
Tamworth, . .	2	39.60	182.00	100	142.3	1.42	5.52	15.30

Basis of valuation per ton: Corn meal, $24; wheat bran, $19; gluten meal, $25; skim-milk, per gallon, 1.8 cents; buttermilk, per gallon, 1.0 cent.

Summary of Cost of Feed consumed for the Production of One Pound of Dressed Pork, based on the Ruling Market Price of the Fodder Articles when used.

BREED.	EXPERIMENT I.			EXPERIMENT II.			EXPERIMENT III.		
	Total Cost.	Net Cost.	Obtainable Manurial Value.	Total Cost.	Net Cost.	Obtainable Manurial Value.	Total Cost.	Net Cost.	Obtainable Manurial Value.
	Cents.	Cents	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.
Small Yorkshire,	4.79	3.14	1.65	5.68	4.14	1.54	6.36	4.86	1.50
Berkshire,	4.80	3.13	1.67	5.20	3.74	1.46	6.07	4.59	1.48
Poland China,	4.57	2.98	1.59	5.50	4.00	1.50	5.79	4.40	1.39
Tamworth,	4.52	2.97	1.55	-	-	-	6.33	4.78	1.55

Local Market Cost of the Various Articles of Fodder used during the Three Experiments.

	Experiment I.	Experiment II.	Experiment III.
Corn meal, per ton,	$24 00	$27 00	$31 00
Wheat bran, per ton,	19 00	25 00	23 00
Gluten meal, per ton,	25 00	28 00	27 00
Buttermilk, per gallon,	0 01	-	-
Skim-milk, per gallon,	0 018	0 018	0 018

Relative Cost of Feed per Pound of Dressed Pork (Cents), based on the Lowest and Highest Market Price.

	I.	II.
Corn meal, per ton,	$24 00	$31 00
Wheat bran, per ton,	19 00	23 00
Gluten meal, per ton,	25 00	27 00
Skim-milk, per gallon,	1.8 cents.	1.8 cents.
Buttermilk, per gallon,	1.0 cent.	1.0 cent.

I.

	Experiment I.	Experiment II.	Experiment III.
	Cents.	Cents.	Cents.
Small Yorkshire, No. 1,	4.79	5.04	5.53
Small Yorkshire, No. 2,		5.34	5.68
Berkshire, No. 1,	4.80	4.78	5.43
Berkshire, No. 2,		4.81	5.21
Berkshire, No. 3,		–	–
Poland China, No 1,	4.57	4.98	4.87
Poland China, No. 2,	–	–	5.30
Tamworth, No. 1,	4.52	–	5.28
Tamworth, No. 2,		–	5.76
II.			
Small Yorkshire, No. 1,	5.58	5.80	6.25
Small Yorkshire, No. 2,		5.30	6.46
Berkshire, No. 1,	5.57	5.40	6.20
Berkshire, No. 2,		5.42	5.93
Berkshire, No. 3,		–	–
Poland China, No. 1,	5.33	5.75	5.54
Poland China, No. 2,	–	–	6.03
Tamworth, No. 1,	5.26	–	6.06
Tamworth, No. 2,		–	6.59

Conclusions.

1. *The average amount of dry matter consumed* per pound of dressed pork produced differs for different breeds as follows: First experiment, in case of Tamworths and Poland Chinas, from 3.13 to 3.20 pounds; in case of Berkshires and Small Yorkshires, from 3.31 to 3.32 pounds. Second experiment, in case of Berkshires and Small Yorkshires, from 3.04 to 3.42 pounds; Poland Chinas, 3.32 pounds; Tamworths ruled out, on account of sickness in the second experiment. Third experiment, in case of Poland Chinas and Tamworths, from 3.12 to 3.48 pounds; and in case of Berkshires and Small Yorkshires, from 3.31 to 3.36 pounds. Summing up the results of the three experiments in this connection, it appears that in our case the larger build breeds lead the smaller breeds in two out of three cases. The difference between breeds is apparently not more marked than the difference between animals of the same breed.

2. *The average gain in live weight per day* differs in the first trial, between Small Yorkshires and Berkshires, from

1.19 to 1.20 pounds; Poland Chinas and Tamworths are even, 1.38 pounds; in the second experiment, Small Yorkshires 1.01 to Berkshires .9 pounds; Poland Chinas 1.01 pounds; in the third experiment, Small Yorkshires 1.15, Berkshires 1.35, Poland Chinas 1.38 and Tamworths 1.42 pounds. The Berkshires lead the Small Yorkshires in two out of three experiments, while the Poland Chinas and Tamworths show practically no difference in that respect.

3. *The cost of feed per pound of dressed pork produced* varies in case of different breeds in the successive experiments as follows: First experiment, Small Yorkshires and Berkshires, from 4.79 to 4.80 cents, and Tamworths and Poland Chinas 4.52 to 4.57 cents; second experiment, Berkshires and Small Yorkshires 4.80 to 5.19 cents, Poland Chinas 4.98 cents; third experiment, Berkshires and Small Yorkshires from 5.32 to 5.61 cents, and Poland Chinas and Tamworths from 5.09 to 5.52 cents. The Berkshires lead the Small Yorkshires in two out of three trials, and the Poland Chinas and Tamworths compare well with each other in two trials. The cost of feed in the previous statement is based on the contemporary market price of the different grain feeds, which during the third experiment were exceptionally high, as may be seen from previous reports.

4. The average net cost of the feed consumed per pound of dressed pork produced, allowing a loss of 30 per cent. of the essential manurial constituents of the feed consumed, compares as follows: First experiment, Small Yorkshires, 3.14 cents; Berkshires, 3.13 cents; Poland Chinas, 2.98 cents; Tamworths, 2.92 cents. Second experiment, Small Yorkshires, 4.14 cents; Berkshires, 4.70 cents; Poland Chinas, 4.00 cents. Third experiment, Small Yorkshires, 4.86 cents; Berkshires, 4.59 cents; Poland Chinas, 4.40 cents; and Tamworths, 4.78 cents. The value of the obtainable manure averages in the first experiment, per pound of dressed pork sold, 1.61 cents; second experiment, 1.50 cents; and in the third experiment, 1.48 cents, — which is equal to from one-quarter to one-third of the total cost of the feed consumed. The commercial value of the manurial constituents of the feed consumed during our three feeding experiments amounts to $12.39, of which from eight to nine dollars' worth may be saved.

Detailed Statement of Third Experiment.

Small Yorkshire, No. 1 (Experiment III.).

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period (Pounds).
1891.								
April 28 to June 22, .	37.88	303.00	14.48	28.96	1:3.14	26.00	83.25	1.02
June 23 to July 27, .	63.53	175.00	19.75	19.75	1:4.19	83.25	127.00	1.25
July 28 to Sept. 7, .	114.19	202.00	19.22	19.22	1:4.82	127.00	182.00	1.31

Total Amount of Feed consumed from April 28 to Sept. 7, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
215.60 pounds corn meal, . . .	182.59	$3 34	$0 66
680.00 quarts skim-milk, . . .	130.14	3 06	1 23
53.45 pounds wheat bran, . .	46.51	0 61	0 30
67.93 pounds gluten meal, . .	60.38	0 92	0 50
	419.62	$7 93	$2 69

	Pounds.
Live weight of animal at beginning of experiment, ...	26.00
Live weight at time of killing, ...	182.00
Live weight gained during experiment, ...	156.00
Dressed weight at time of killing, ...	148.00
Loss in weight by dressing, . . . 34 pounds, or 18.68 per cent.	
Dressed weight gained during experiment, ...	126.86

2.69 pounds of dry matter fed yielded 1 pound of live weight, and 3.31 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.25 cents.

Net cost of feed for production of 1 pound of dressed pork, allowing a loss of 30 per cent. of the manurial value of the feed, 4.77 cents.

Detailed Statement of Third Experiment — Continued.

Small Yorkshire, No. 2 (Experiment III.)

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1891.								
April 28 to June 22,	37.88	303.00	14.48	28.96	1:3.14	26.50	77.75	0.92
June 23 to July 27,	63.50	175.00	19.75	19.75	1:4.19	77.75	119.50	1.19
July 28 to Sept. 30,	167.15	316.00	24.45	24.45	1:4.78	119.50	200.50	1.25

Total Amount of Feed consumed from April 28 to Sept. 30, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
268.53 pounds corn meal,	227.42	$4 16	$0 82
794.00 quarts skim-milk,	151.97	3 57	1 44
58.68 pounds wheat bran,	51.06	0 67	0 33
73.16 pounds gluten meal,	65.03	0 99	0 54
	495.48	$9 39	$3 13

	Pounds.
Live weight of animal at beginning of experiment,	26.50
Live weight at time of killing,	200.50
Live weight gained during experiment,	174.00
Dressed weight at time of killing,	167.50
Loss in weight by dressing,	33 pounds, or 16.46 per cent.
Dressed weight gained during experiment,	145.36

2.85 pounds of dry matter fed yielded 1 pound of live weight, and 3.41 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.46 cents.

Net cost of feed for production of 1 pound of dressed pork, allowing a loss of 30 per cent. of manurial value of feed, 4.95 cents.

Detailed Statement of Third Experiment — Continued.

Berkshire, No. 1 (Experiment III.).

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1891.								
May 26 to July 20, . .	34.25	280.00	24.61	49.22	1:3.12	25.50	88.50	1.13
July 21 to Aug. 17, . .	53.63	132.00	21.88	21.88	1:4.23	88.50	129.00	1.45
Aug. 18 to Sept. 30, . .	149.82	219.00	33.97	33.97	1:4.91	129.00	203.00	1.72

Total Amount of Feed consumed from May 26 to Sept. 30, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
237.70 pounds corn meal, . . .	201.31	$3 68	$0 72
631.00 quarts skim-milk, . . .	120.77	2 84	1 14
80.46 pounds wheat bran, . .	70.01	0 93	0 45
105.07 pounds gluten meal, . .	93.40	1 42	0 77
	485.49	$8 87	$3 08

	Pounds.
Live weight of animal at beginning of experiment, . . .	25.50
Live weight at time of killing, ...	203.00
Live weight gained during experiment, ...	177.50
Dressed weight at time of killing, ...	163.50
Loss in weight by dressing, . . . 39½ pounds, or 19.46 per cent.	
Dressed weight gained during experiment, ...	142.96

2.74 pounds of dry matter fed yielded 1 pound of live weight, and 3.40 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.20 cents.

Net cost of feed for production of 1 pound of dressed pork, allowing a loss of 30 per cent. of the manurial value of the feed, 4.69 cents.

Detailed Statement of Third Experiment — Continued.

Berkshire, No. 2 (Experiment III.).

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1891.								
May 26 to July 20, . .	35.00	280.00	23.69	47.38	1:3.13	22.75	85.50	1.12
July 21 to Aug. 17, . .	52.25	132.00	20.87	20.87	1:4.21	85.50	121.50	1.29
Aug. 18 to Sept. 30, . .	134.41	219.00	26.26	26.26	1:4.86	121.50	192.00	1.60

Total Amount of Feed consumed from May 26 to Sept. 30, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
221.66 pounds corn meal, . . .	187.72	$3 44	$0 68
631.00 quarts skim-milk, . . .	120.77	2 84	1 14
70.82 pounds wheat bran, . .	61.62	0 81	0 40
94.51 pounds gluten meal, . .	84.01	1 28	0 70
	454.12	$8 37	$2 92

	Pounds.
Live weight of animal at beginning of experiment, . . .	22.75
Live weight at time of killing, ...	192.00
Live weight gained during experiment, ...	169.25
Dressed weight at time of killing, ...	160.00
Loss in weight by dressing, . . . 32 pounds, or 16.67 per cent.	
Dressed weight gained during experiment, ...	141.04

2.68 pounds of dry matter fed yielded 1 pound of live weight, and 3.22 pounds of dry matter yielded 1 pound dressed weight.

Cost of feed for production of 1 pound of dressed pork, 5.93 cents.

Net cost of feed for production of 1 pound of dressed pork, allowing a loss of 30 per cent. of the manurial value of the feed, 4.49 cents.

Detailed Statement of Third Experiment — Continued.

Poland China, No. 1 (Experiment III.).

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1891.								
May 12 to July 6, . .	35.25	282.00	15.88	31.75	1:3.14	23.75	90.00	1.18
July 7 to July 27, . .	41.88	105.00	15.63	15.63	1:4.23	90.00	122.00	1.52
July 28 to Sept. 7, . .	131.31	202.00	27.78	27.78	1:4.89	122.00	195.25	1.74

Total Amount of Feed consumed from May 12 to Sept. 7, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
208.44 pounds corn meal, . . .	176.53	$3 23	$0 64
589.00 quarts skim-milk, . . .	112.73	2 65	1 07
59.29 pounds wheat bran, . .	51.59	0 68	0 33
75.16 pounds gluten meal, . .	66.81	1 01	0 55
	407.66	$7 57	$2 59

	Pounds.
Live weight of animal at beginning of experiment, . .	23.75
Live weight at time of killing, ...	195.25
Live weight gained during experiment, ...	171.50
Dressed weight at time of killing, ...	155.50
Loss in weight by dressing, . .	40 pounds, or 20.46 per cent
Dressed weight gained during experiment, ...	136.61

2.38 pounds dry matter fed yielded 1 pound live weight, and 2.98 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 5.54 cents.

Net cost of feed for production of 1 pound of dressed pork, allowing a loss of 30 per cent. of manurial value of feed, 4.22 cents.

Detailed Statement of Third Experiment — Continued.

Poland China, No. 2 (Experiment III.).

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-Milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1891.								
May 12 to July 6, . .	35.25	282.00	13.31	26.63	1:3.14	23.50	77.50	0.96
July 7 to Aug. 3, . .	56.13	140.00	22.38	22.38	1:4.23	77.50	121.50	1.57
Aug. 4 to Sept. 7, . .	112.93	167.00	25.41	25.41	1:4.91	121.50	180.00	1.67

Total Amount of Feed consumed from May 12 to Sept. 7, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
204.31 pounds corn meal, . . .	173.03	$3 17	$0 62
589.00 quarts skim-milk, . . .	112.73	2 65	1 07
61.10 pounds wheat bran, . .	53.16	0 70	0 34
74.42 pounds gluten meal, . .	66.15	1 00	0 55
	405.07	$7 52	$2 58

	Pounds.
Live weight of animal at beginning of experiment, . .	23.50
Live weight at time of killing, ...	180.00
Live weight gained during experiment, ...	156.50
Dressed weight at time of killing, ...	143.50
Loss in weight by dressing, . .	36½ pounds, or 20.28 per cent.
Dressed weight gained during experiment, ...	124.77

2.59 pounds of dry matter fed yielded 1 pound of live weight, and 3.25 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.03 cents.

Net cost of feed for production of 1 pound of dressed pork, allowing a loss of 30 per cent. of manurial value of feed, 4.58 cents.

Detailed Statement of Third Experiment — Continued.

Tamworth, No. 1 (Experiment III.).

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at Close of Period (Pounds).	Gain in Weight per Day (Pounds).
1891.								
May 5 to June 8, . .	24.50	196.00	19.15	38.29	1:3.12	41.50	90.00	1.39
June 9 to July 6, . .	58.00	140.00	23.00	23.00	1:4.25	90.00	123.50	1.20
July 7 to Aug. 12, . .	127.57	174.00	31.09	31.09	1:4.94	123.50	184.50	1.65

Total Amount of Feed consumed from May 5 to Aug. 12, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
210.07 pounds corn meal, . . .	177.91	$3 26	$0 64
510.00 quarts skim-milk, . . .	97.61	2 30	0 92
73.24 pounds wheat bran, . .	63.73	0 84	0 41
92.38 pounds gluten meal, . .	82.12	1 25	0 68
	421.37	$7 65	$2 65

	Pounds.
Live weight of animal at beginning of experiment, . . .	41.50
Live weight at time of killing, ...	184.50
Live weight gained during experiment, ...	143.00
Dressed weight at time of killing, ...	163.00
Loss in weight by dressing, . . . 21½ pounds, or 11.65 per cent.	
Dressed weight gained during experiment, ...	126.33

2.95 pounds of dry matter fed yielded 1 pound of live weight, and 3.34 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.06 cents.

Net cost of feed for production of 1 pound of dressed pork, allowing a loss of 30 per cent. of manurial value of feed, 4.58 cents.

Detailed Statement of Third Experiment — Continued.

Tamworth, No. 2 (Experiment III.).

FEEDING PERIODS.	Total Amount of Corn Meal consumed (Pounds).	Total Amount of Skim-milk consumed (Quarts).	Total Amount of Wheat Bran consumed (Pounds).	Total Amount of Gluten Meal consumed (Pounds).	Nutritive Ratio of Feed.	Weight of Animal at Beginning of Period (Pounds).	Weight of Animal at End of Period (Pounds).	Gain in Weight per Day during Period (Pounds).
1891.								
May 5 to June 8, .	24.50	196.00	19.27	38.54	1:3.12	37.75	85.50	1.36
June 9 to July 6, .	59.69	140.00	24.69	24.69	1:4.26	85.50	122.50	1.32
July 7 to Aug. 12, .	122.38	174.00	28.50	28.50	1:4.92	122.50	179.50	1.54

Total Amount of Feed consumed from May 5 to Aug. 12, 1891.

	Dry Matter (Pounds).	Cost.	Manurial Value.
206.57 pounds corn meal, . .	174.94	$3 20	$0 63
510.00 quarts skim-milk, . . .	97.61	2 30	0 92
72.46 pounds wheat bran, .	63.05	0 83	0 41
91.73 pounds gluten meal, . .	81.54	1 24	0 68
	417.14	$7 57	$2 64

	Pounds.
Live weight of animal at beginning of experiment, . .	37.75
Live weight at time of killing, ...	179.50
Live weight gained during experiment, ...	141.75
Dressed weight at time of killing, ...	145.50
Loss in weight by dressing, . . . 34 pounds, or 18.94 per cent.	
Dressed weight gained during experiment, ...	114.90

2.94 pounds of dry matter fed yielded 1 pound of live weight, and 3.63 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for production of 1 pound of dressed pork, 6.59 cents.

Net cost of feed for production of 1 pound of dressed pork, allowing a loss of 30 per cent of manurial value of feed, 4.98 cents.

Detailed Statement of Third Experiment — Concluded.

Summary of Gain in Weight (Experiment III.).

SUMMER, 1891.	LIVE WEIGHT AT BEGINNING (POUNDS.)		LIVE WEIGHT WHEN KILLED (POUNDS)		GAIN IN LIVE WEIGHT (POUNDS).	
	No. 1.	No. 2.	No. 1.	No. 2.	No. 1.	No. 2.
Small Yorkshires,	26.00	26.50	182.00	200.50	156.00	174.00
Poland Chinas, .	23.75	23.50	195.25	180.00	171.50	156.50
Berkshires, . .	25.50	22.75	203.00	192.00	177.50	169.25
Tamworths, . .	41.50	37.75	184.50	179.50	143.00	141.75

SUMMER, 1891.	NUMBER OF DAYS OF FEEDING.		GAIN IN LIVE WEIGHT PER DAY (POUNDS).	
	No. 1.	No. 2	No. 1.	No. 2.
Small Yorkshires, ...	133	156	1.17	1.12
Poland Chinas, . . .	119	119	1.44	1.32
Berkshires, ...	128	128	1.39	1.32
Tamworths, ...	100	100	1.43	1.42

Fodder Analyses.

Corn Meal (Experiment I.).

1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C., . .	12.39	247.80	–	–	1 : 9.70
Dry matter, . . .	87.61	1,752.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash, ...	1.80	36.00	–	–	
" cellulose, . . .	1.80	36.00	12.24	34	
" fat, ...	5.01	100.20	76.15	76	
" protein (nitrogenous matter), . .	10.46	209.20	177.82	85	
Non-nitrogenous extract matter, ...	80.93	1,618.60	1,521.48	94	
	100.00	2,000.00	1,787.69	–	

Fodder Analyses — Continued.

Wheat Bran (Experiment I.).

1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.52	230.40	–	–	1 : 3.71
Dry matter,	88.48	1,769.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.13	142.60	–	–	
" cellulose,	10.63	212.60	42.52	20	
" fat,	5.62	112.40	89.92	80	
" protein (nitrogenous matter),	18.36	367.20	323.14	88	
Non-nitrogenous extract matter,	58.26	1,165.20	932.16	80	
	100.00	2,000 00	1,387.74	–	

Gluten Meal (Experiment I).

1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.48	169.60	–	–	1 : 2.22
Dry matter,	91.52	1,830.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	0.76	15.20	–	–	
" cellulose,	0.68	13.60	4.62	34	
" fat,	11.14	222.80	169.33	76	
" protein (nitrogenous matter),	36.59	731.80	622.03	85	
Non-nitrogenous extract matter,	50.83	1,016.60	955.60	94	
	100.00	2,000.00	1,751.58	–	

Fodder Analyses — Continued.

Buttermilk (Experiment I.).

1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	93.34	1,866.80	–	–	1 : 1.72
Dry matter,	6.66	133.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	7.51	150.20	–	–	
" fat,	4.80	96.00	96.00	100	
" protein (nitrogenous matter),	36.64	732.80	732.80	100	
Non-nitrogenous extract matter,	51.05	1,021.00	1,021.00	100	
	100.00	2,000.00	1,849.80	–	

Skim-milk (Experiments I. and II.).

1890.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	89.78	1,795.60	–	–	
Dry matter,	10.22	204.40	–	–	1 : 2.13
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.85	137.00	–	–	
" fat,	3.82	76.40	76.40	100	
" protein (nitrogenous matter),	31.60	632.00	632.00	100	
Non-nitrogenous extract matter,	57.73	1,155.60	1,155.60	100	
	100.00	2,000.00	1,864.00	–	

NOTE. — The analysis of the grain feed used during the second experiment is the same as of these articles stated in connection with the preceding corn-feeding experiment for the same period of time.

Fodder Analyses — Continued.

Corn Meal (Experiment III.).

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	15.31	303.20	–	–	1 : 9.23
Dry matter,	84.69	1,697.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.72	34.40	–	–	
" cellulose,	2.17	43.40	20.83	48	
" fat,	4.84	96.80	82.28	85	
" protein (nitrogenous matter),	12.18	243.60	192.44	79	
Non-nitrogenous extract matter,	79.09	1,581.80	1,550.16	98	
	100.00	2,000.00	1,845.71	–	

Wheat Bran (Experiment III.).

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.99	259.80	–	–	1 : 4.73
Dry matter,	87.01	1,740.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.23	124.60	–	–	
" cellulose,	10.47	209.40	50.26	24	
" fat,	5.37	107.40	76.25	71	
" protein (nitrogenous matter),	16.16	323.20	252.10	78	
Non-nitrogenous extract matter,	61.77	1,235.40	951.26	77	
	100.00	2,000.00	1,329.87	–	

Fodder Analyses — Concluded.

Gluten Meal (Experiment III.).

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.11	222.20	–	–	1 : 2.66
Dry matter,	88.89	1,777.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	1.65	33.00	–	–	
" cellulose,	0.73	14.60	9.05	62	
" fat,	9.22	184.40	156.74	85	
" protein (nitrogenous matter),	33.34	666.80	526.77	79	
Non-nitrogenous extract matter,	55.06	1,101.20	1,002.09	91	
	100.00	2,000.00	1,694.65	–	

Skim-milk (Experiment III.).

1891.

	Percentage Composition.	Constituents (in Pounds) in a Ton of 2,000 Pounds.	Pounds Digestible in a Ton of 2,000 Pounds.	Per Cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	91.18	1,823.60	–	–	1 : 2.16
Dry matter,	8.82	176.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude ash,	6.80	136.00	–	–	
" fat,	4.20	84.00	84.00	100	
" protein (nitrogenous matter),	31.52	630.40	630.40	100	
Non-nitrogenous extract matter,	57.48	1,149.60	1,149.60	100	
	100.00	2,000.00	1,864.00	–	

PART II.

ON

FIELD EXPERIMENTS

AND

OBSERVATIONS IN VEGETABLE PHYSIOLOGY

AND

PATHOLOGY.

1. Effect of Different Kinds of Nitrogen-containing Manurial Substances on the Yield of Rye (Field A).
2. Experiments with Prominent Varieties of Grasses and with Grass Mixtures, to ascertain their Comparative Economical Value under fairly Corresponding Circumstances (Field B).
3. Experiments with Reputed Fodder Crops mostly new to our Locality, and with a Series of Garden Crops treated with Different Mixtures of Commercial Fertilizing Ingredients (Field C).
4. Experiment with raising Stowell's Evergreen Sweet Corn for Ensilage (Field D).
5. Experiments with Different Commercial Phosphates, to study the Economy of using Natural Phosphates or Acidulated Phosphates in Farm Practice (Field F).
6. Experiments with a Western Variety of Dent Corn, Pride of the North, for Ensilage (Field G).
7. Experiments with Grass Lands (Meadows).
8. Report on General Farm Work in 1891.
9. Report of Prof. James Ellis Humphrey on Plant Diseases, etc., with Observations in the Field and in the Vegetation House.

1. FIELD EXPERIMENT TO ASCERTAIN THE EFFECT OF DIFFERENT COMBINATIONS OF NITROGEN — I. E., SODIUM NITRATE, CHILI SALTPETRE, AMMONIUM SULPHATE AND NITROGEN-CONTAINING ORGANIC MATTER, UNDER OTHERWISE CORRESPONDING CIRCUMSTANCES — ON RYE (1891).

Field A.

The well-authenticated and unbroken record of this field extends over more than twenty years. The systematic treatment of the soil, as far as modes of cultivation and of manuring are concerned, was introduced during the season of 1883–84. The subdivision of the entire area into eleven plats (one-eighth of an acre each) of a uniform size and shape, one hundred and thirty feet long and thirty feet wide, with an unoccupied and unmanured space of five feet in width between adjoining plats, has been retained unaltered since 1884. A detailed statement of the particular aim and general management of our experiments, as well as of the results obtained in that connection, from year to year forms a prominent part of our contemporary printed annual reports, to which I have to refer for details.

The most conspicuous result of the field experiments carried on upon Field A during the years 1884 to 1888 consists in the very striking illustration of a marked deficiency of the soil on trial on available potash, as compared with other essential articles of plant food.

Since 1889 the main object of observations upon the same field has been to study the influence of both an entire exclusion of any additional nitrogen-containing manurial substance from the soil under cultivation, as well as of a definite additional supply of nitrogen in different forms of combination, on the character and yield of the crop selected for the trial. The treatment of the soil adopted in preceding years favored this new project for field observations.

Several plats which for five preceding years did not receive any nitrogen compound for manurial purposes were retained in that state, to study the effect of an entire exclusion of nitrogen-containing manurial substances on the crop under cultivation, while the remaining ones received as before a definite amount of nitrogen in the same form in which they had received it in preceding years: namely, either as sodium nitrate or as ammonium sulphate, or as organic nitrogenous matter in form of dried blood. A corresponding amount of available nitrogen was applied in all these cases.

Aside from the difference regarding the nitrogen supply, all plats were treated alike. They each received without an exception a corresponding amount of available phosphoric acid and of potassium oxide. The phosphoric acid was supplied, in form of dissolved bone-black, and the potassium oxide either in form of muriate of potash or of potash-magnesia sulphate. From 120 to 130 pounds of potassium oxide, from 80 to 85 pounds of available phosphoric acid and from 40 to 50 pounds of available nitrogen were supplied per acre.

One plat marked 0 received its main supply of phosphoric acid, potassium oxide and nitrogen in form of barn-yard manure; the latter was carefully analyzed before being applied, to determine the amount required to secure, as far as practicable, the desired corresponding proportion of essential fertilizing constituents. The deficiency in potassium oxide and phosphoric acid was supplied by potash-magnesia sulphate and dissolved bone-black. The fertilizer for this plat consisted of 800 pounds of barn-yard manure, 32 pounds of potash-magnesia sulphate and 18 pounds of dissolved bone-black.

The mechanical preparation of the soil, the incorporation of the manurial substances, — the general character of the latter being the same, — the seeding, cultivating and harvesting were carried on year after year in a like manner, and as far as practicable on the same day in case of every plat during the same year.

This course in the general management of the experiment has been followed thus far for three successive years — 1889, 1890 and 1891 — in connection with different crops: —

Corn (maize), in 1889 (see seventh annual report); oats, in 1890 (see eighth annual report); rye, in 1891 (see ninth annual report).

The following tabular statement shows the annual application and special distribution of the manurial substances with reference to each plat since 1889. The fertilizers were in every case applied broadcast as early as circumstances permitted. They were slightly harrowed under before the seed was planted in rows by a seed drill. Each plat received the same amount of seed.

NUMBER OF PLAT.	Annual Supply of Manurial Substances.
Plat 0, .	800 lbs. of barn-yard manure, 32 lbs. of potash-magnesia sulphate and 18 lbs. of dissolved bone-black.
Plat 1, .	29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 2, .	29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 3, .	43 lbs dried blood (= 5 to 6 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 4, .	25 lbs muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs available phosphoric acid).
Plat 5, .	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 6, .	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs muriate of potash (= 12 to 13 lbs potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 7, .	25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs available phosphoric acid).
Plat 8, .	22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs available phosphoric acid).
Plat 9, .	25 lbs muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).
Plat 10, .	43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid).

1891. — The soil of the field being brought by ploughing and harrowing into a good mechanical condition for planting, the entire area was seeded with winter rye Sept. 5, 1890. Each plat received five and one-half pounds of rye in drills two feet apart. The second largest plate was used in the seeding machine.

The young plants appeared above ground October 1. The growth upon Plat 6 and on 8 in particular presented soon after a yellowish-green appearance; otherwise the crop promised well.

The late winter season was somewhat unfavorable to winter crops, — a fact noticed quite generally in our vicinity on grass lands. The rye crop showed signs of winter-killing; the growth upon Plat 2 had apparently suffered more than that on any other plat. The following tabular record shows the rate of growth upon the different plats at different periods of the season, — May 12 to June 16: —

	May 12.	May 19.	May 27.	June 2.	June 10.	June 16.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
Plat 0, . .	19	26	42	61	65	66
Plat 1, . .	21	27	44	60	66	66
Plat 2, . .	21	27	44	60	65	66
Plat 3, . .	21	27	46	63	67	67
Plat 4, . .	17	24	40	58	65	65
Plat 5, . .	19	23	40	59	64	66
Plat 6, . .	8	16	32	50	64	65
Plat 7, . .	20	26	46	60	68	68
Plat 8, . .	6	14	30	44	55	58
Plat 9, . .	19	28	40	61	66	66
Plat 10, . .	22	27	47	62	67	67

The differences noticeable in the above table regarding the rate of growth upon different plats are not less marked than were the variations in the color of the vegetation upon different plats at different stages of the season. The growth upon plats 4, 7, 10, and in particular 9, was of a light-green color; while upon plats 1 and 2 it was of a marked deep-green shade. This feature in the appearance of the vegetation over the entire area was quite marked during the entire season until the crop began to mature. Plats 4, 7 and 9 turned yellow, while plats 1, 2, 5, 6 and 8 were still green (July 9). The entire crop was cut July 16, and carried into the barn July 18. The subsequent tables show the difference in moisture of the crop from different plats when carried into the barn, as compared with a more uniform condition in that direction after two months' storing in the barn: —

	Weight when Harvested (July 18, 1891).	Weight when Threshed (Sept. 22, 1891).	Loss of Moisture.
	Pounds.	Pounds.	Per Cent.
Plat 0,	695	470	32.37
Plat 1,	790	570	27.85
Plat 2,	700	525	25.00
Plat 3,	605	475	21.49
Plat 4,	490	390	20.41
Plat 5,	660	530	19.70
Plat 6,	505	400	20.79
Plat 7,	495	450	9.09
Plat 8,	–	–	–
Plat 9,	495	425	14.14
Plat 10,	520	425	18.27

Plat 8 is excluded from the statement on account of a partial destruction of the crop by insects. The total yield of straw and grain obtained from different plats varies from 390 to 570 pounds in weight.

The relation of the grain to the straw and chaff will be found in the statement below: —

	Grain and Straw.	Grain.	Straw and Chaff.	Percentage of Grain.	Percentage of Straw and Chaff.
	Pounds.	Pounds.	Pounds.		
Plat 0,	470	142	328	30.21	69.79
Plat 1,	570	154	416	27.02	72.98
Plat 2,	525	134	391	25.52	74.48
Plat 3,	475	130	345	27.37	72.63
Plat 4,	390	107	283	27.44	72.56
Plat 5,	530	145	385	27.36	72.64
Plat 6,	400	102	298	25.50	74.50
Plat 7,	450	109	341	24.22	75.78
Plat 8,	–	–	–	–	–
Plat 9,	425	109	316	25.65	74.35
Plat 10,	425	125	300	29.41	70.59
	4,875	1,303	3,572	–	–

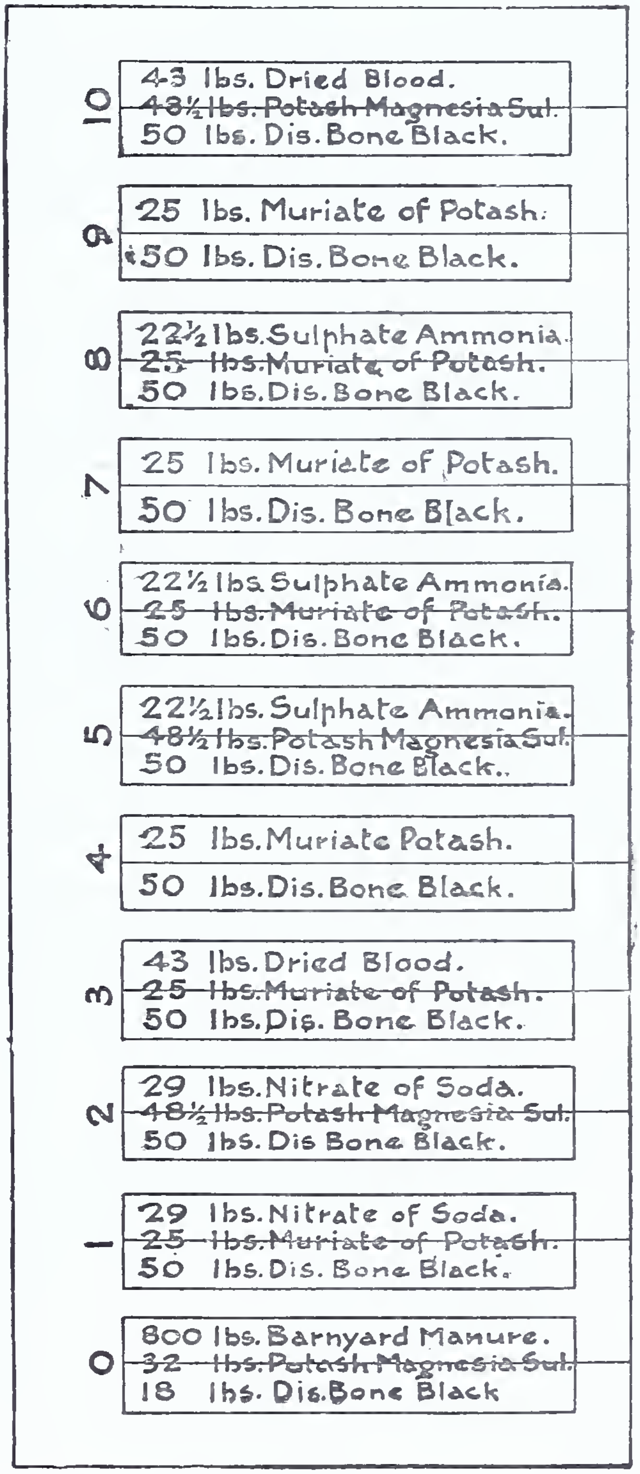
The yield of the grain for the entire field in case of the air-dry crop averages 26.72 per cent. and that of the straw and chaff 73.28 per cent. The yield of the grain upon different plats varies from 102 pounds to 154 pounds. Plat

2 differs in yield from Plat 1, probably on account of a more serious degree of winter-killing, as has been stated on a previous page. Plat 6 shows still the serious influence of several years' fallow (1885 to 1888), without the application of manure and without the cultivation of a crop (black fallow), on the productiveness of the soil thus treated. The low yield of grain (107 to 109 pounds) upon plats 4, 7 and 9, which did not receive any nitrogen-containing manurial matter, is a very significant result. The belief in the beneficial influence of a liberal supply of nitrogen on the quantity and the quality of grain crops is evidently well sustained by the results of the above-described experiment.

Summary of Three Years' Observations upon Field A (1889–91).

Number of Plat.	MANURIAL MATTER APPLIED.	1889.	1890. Yield of Oats.			1891. Yield of Rye.				
		Yield of Dry Fodder Corn.	Crop (Pounds).	Percentage of Grain.	Percentage of Straw and Chaff.	Crop (Pounds).	Percentage of Grain.	Percentage of Straw and Chaff.	Yield of Grain (Pounds).	Yield of Straw (Pounds).
		Pounds.								
Plat 0,	800 lbs. of barn-yard manure, 32 lbs. of potash-magnesia sulphate and 18 lbs. of dissolved bone-black, ...	-	315	38.10	61.90	470	30.21	69.79	142	328
Plat 1,	29 lbs. sodium nitrate (=4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid),	648	362	35.36	64.64	570	27.02	72.98	154	416
Plat 2,	29 lbs. sodium nitrate (=4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (=12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), .	577	365	35.34	64.66	525	25.52	74.48	134	391
Plat 3,	43 lbs. dried blood (=5 to 6 lbs. nitrogen), 25 lbs muriate of potash (=12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), .	618	345	33.62	66.38	475	27.37	72.63	130	345
Plat 4,	25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), ...	381	260	34.61	63.39	390	27.44	72.56	107	283
Plat 5,	22.5 lbs. ammonium sulphate (=4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (=12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), ...	488	360	39.20	60.80	530	27.36	72.64	145	385
Plat 6,	22.5 lbs. ammonium sulphate (=4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid),	542	385	32.21	67.79	400	25.50	74.50	102	298
Plat 7,	25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), ...	526	320	34.40	65.60	450	24.22	75.78	109	341
Plat 8,	22.5 lbs. ammonium sulphate (=4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid), .	359	220	26.82	73.18	-	-	-	-	-
Plat 9,	25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid).	476	290	34.83	65.17	425	25.65	74.35	109	316
Plat 10,	43 lbs. dried blood (=5 to 6 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (=12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid),	640	395	35.44	64.56	425	29.41	70.59	125	300

FIELD "A," 1891.



SCALE, 4 RODS TO 1 INCH.

RYE PLATS.

2. Field Experiment with Prominent Varieties of Grasses, to study Their Composition under fairly Corresponding Conditions, as far as Soil and Manure are concerned, and to compare Their Economical Value when raised by Themselves as well as in Case of Mixtures (1891).

Field B.

This field occupies an area of one and seven-tenths acres, and runs from north to south, nearly on a level. The soil consists of a somewhat sandy loam of several feet in depth. The systematic treatment of the area was inaugurated in 1884, when the present subdivision into eleven plats was first introduced. The plats are 175 feet long and 33 feet wide (5,775 square feet, or two-fifteenths of an acre), of a uniform shape, running from east to west, with a space of five feet between adjoining plats. The numbering begins at the north end with 11, and closes at the south end with 21. From 1884 to 1889 every alternate plat received annually the same kind and the same amount of fertilizer, — 600 pounds of fine-ground bone and 200 pounds of muriate of potash per acre. Plats 11, 13, 15, 19 and 21 were annually manured as stated, and plats 12, 14, 16, 18 and 20 received no manurial matter of any description during that period (1884 to 1889). The space of five feet left between the different succeeding plats has been kept clean from any growth by a constant use of the cultivator, and received at no time any kind of manure.

The details of the work carried on upon Field B have been thus far reported from year to year in our annual reports. The chemical analyses of the crops raised upon this field, on account of the amount of work involved, have been quite frequently published in later bulletins or in annual reports of the succeeding year.

A material change in the above-stated management of the field was made in 1889, with reference to the previously unmanured plats, 12, 14, 16, 18 and 20; they were subsequently annually manured in exactly the same manner as the remaining plats, receiving per acre 600 pounds of fine-ground bone and 200 pounds of muriate of potash. The character of the crops raised upon the various plats since 1888 to date may be seen from the following tabular statement: —

PLATS.	1888.	1889.	1890.	1891.
Plat 11 (fertilized),	Kentucky blue-grass (*Poa pratensis*),	Kentucky blue-grass,	Kentucky blue-grass, sown Sept. 24, 1889,	Kentucky blue-grass, sown Sept. 24, 1889.
Plat 12 (unfertilized),	Kentucky blue-grass,	Kentucky blue-grass,	Kentucky blue-grass, sown Sept. 24, 1889,	Kentucky blue-grass, sown Sept. 24, 1889.
Plat 13 (fertilized),	Italian rye-grass, English rye-grass,	Red-cob ensilage corn,	Red top, sown Sept. 24, 1889,	English rye-grass, north, sown Sept. 29, 1889. Italian rye-grass, south, sown Sept. 29, 1889.
Plat 14 (unfertilized),	Italian rye-grass, English rye-grass,	Red-cob ensilage corn,	Red top, sown Sept. 24, 1889,	English rye-grass and red top, sown Sept. 29, 1890.
Plat 15 (fertilized),	Soja bean (*Soja hispida*),	Bokhara clover (*Melilotus alba*), Sainfoin (*Onobrychis sativa*),	Bokhara clover, sown May 8, 1889, Sainfoin, sown May 8, 1889,	Herds grass and red top, sown April 23, 1890.
Plat 16 (unfertilized),	Soja bean,	Bokhara clover, Sainfoin,	Rhode Island bent (*Agrostis alba*), sown Sept. 25, 1889,	Italian rye-grass and red top, sown April 23, 1890.
Plat 17 (fertilized),	Meadow fescue,	Meadow fescue,	Meadow fescue, sown September, 1887,	Meadow fescue, sown September, 1887.
Plat 18 (unfertilized),	Alsike clover, Medium red clover,	Red-cob ensilage corn,	Meadow fescue, sown September, 1889,	Meadow fescue, sown Sept. 29, 1890.
Plat 19 (fertilized),	Alsike clover, Medium red clover,	Alsike clover, Medium red clover,	Herds grass, sown September, 1889,	Herds grass, sown Sept. 25, 1889.
Plat 20 (unfertilized),	Mammoth red clover, Alfalfa,	Red-cob ensilage corn,	Red top and herds grass mixed, sown September, 1889,	Herds grass and red top, sown Sept. 29, 1890.
Plat 21 (fertilized),	Mammoth red clover, Alfalfa,	Corn (variety, Clark),	Meadow fescue and herds grass, mixed, sown September, 1889,	Meadow fescue and red top, sown Sept. 29, 1890.

1891. — Previous to the year 1891 other crops than grasses have been cultivated upon some plats at times. Of late none but single grasses or mixtures of reputed grasses have been planted. The single grasses are raised as in previous years in rows two feet apart; grass mixtures are seeded down broadcast. The manure in case of single grasses is applied by hand between the rows, and is subsequently slightly ploughed in by means of a cultivator; in case of grass mixtures the manure is applied as top dressing early in the spring. In both cases the first manure is applied broadcast and ploughed under before seeding down the grass.

Plat 11, Kentucky blue-grass (*Poa pratensis*), sown Sept. 24, 1889, in rows. The grass looked well in the spring; the growth between the rows was removed with the cultivator and the hoe, to secure as far as practicable a clean crop. The grass began to bloom June 5, when 27 inches high; it was cut when the seed began freely to set (June 17).

Plat 12, Kentucky blue-grass (*Poa pratensis*), sown Sept. 24, 1889. The grass on this plat showed signs of winter-killing. The crop was cut June 17. The yield of both plats, 11 and 12, amounted to 260 pounds of hay (975 pounds per acre) when removed to the barn. This plat (12) was ploughed July 8, 1891, the sod thoroughly cut up with a wheel harrow, properly harrowed and seeded down Sept. 18, 1891, with a mixture of four pounds each of Kentucky blue-grass and red top. The grass was well above ground Sept. 28, 1891.

Plat 13, English rye-grass (*Lolium perenne*) and Italian rye-grass (*Lolium Italicum*), each occupying one-half of the plat. Both were sown in rows Sept. 29, 1890. The Italian rye-grass was in better condition at the beginning of the spring than the English rye-grass. The latter had suffered in a considerable degree from winter-killing. The winter-killed spots were re-seeded at an early date. Both grasses bloomed fairly June 18; they were cut June 24. The first cut of hay amounted to one hundred pounds in each case (1,500 pounds per acre). The second cut of the English rye-grass yielded 120 pounds (1,800 pounds per acre) August 18, while the Italian rye-grass yielded 90 pounds (1,350 pounds per acre).

Plat 14, a mixture of English rye-grass and of red top, equal weights, sown broadcast Sept. 29, 1890. The crop was cut June 24; red top was not yet in bloom. The first crop amounted to 355 pounds of hay (2,662 pounds per acre); the second cut, August 31, yielded 90 pounds of hay (675 pounds per acre).

Plat 15, herds grass (*Phleum pratense*) and red top (*Agrostis vulgaris*), sown broadcast April 23, 1890. The crop was to such an extent infested with shepherd's purse that no record of yield was kept. The growth upon the plat was mowed whenever the weeds showed themselves above the grasses, to ascertain whether a repeated cutting during the first season will free the plat from that particular trouble.

Plat 16, Italian rye-grass and red top, sown broadcast April 23, 1890. The growth upon this plat suffered from the same causes as the preceding plat, — namely, from shepherd's purse, — and from the seeding down of grasses during spring time. The seeding down of grass lands in the spring is known to be an objectionable practice. Our experiment is made to furnish an illustration in that direction, and also to point out if possible some remedies.

Plat 17, meadow fescue (*Festuca pratensis*), sown in rows two feet apart, Sept. 25, 1887. The crop looked healthy every way throughout the season. It was in bloom June 15, when 38 inches high. The first cut, June 16, amounted to 450 pounds of hay (3,375 pounds per acre); and the second cut, September 1, to 140 pounds (1,050 pounds per acre).

Plat 18, meadow fescue, sown in rows two feet apart, Sept. 29, 1890. The grass looked healthy and vigorous during the entire period of growth. It bloomed June 20 and was cut June 25. The first cut yielded 190 pounds of hay (1,425 pounds per acre); and the second cut, September 1, yielded 170 pounds (1,275 pounds per acre).

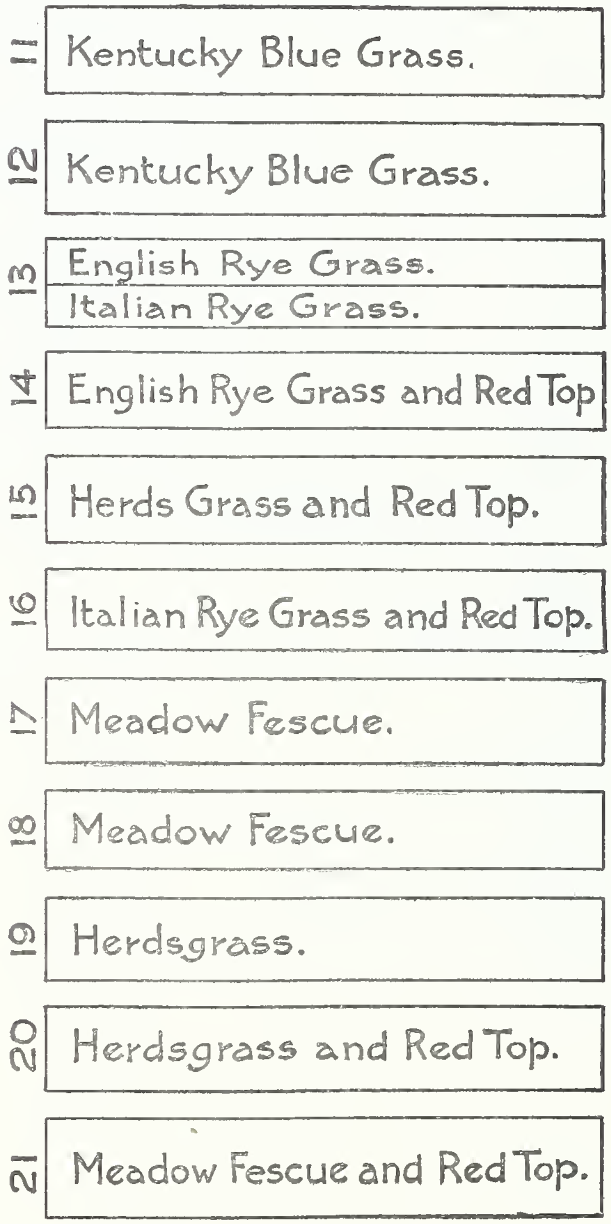
Plat 19, herds grass (*Phleum pratense*), sown in rows two feet apart, Sept. 25, 1889. The growth looked well throughout the season; it began to bloom June 25 and was cut July 1. The hay obtained weighed 630 pounds (4,725 pounds per acre).

Plat 20, mixture of herds grass and red top, sown broadcast Sept. 29, 1890. The herds grass was in bloom June 30; red top showed no flower at that time. The crop was cut July 1, and yielded 430 pounds of hay (3,225 pounds per acre).

Plat 21, meadow fescue (*Festuca pratensis*) and red top (*Agrostis vulgaris*), sown broadcast Sept. 29, 1890. The growth did not correspond to the seeds named. The first cut yielded, June 25, 650 pounds of hay (4,875 pounds per acre). The plat was ploughed, and the soil after thorough mechanical preparation was re-seeded September 18 with a mixture of four pounds of meadow fescue and four pounds of red top.

From the previous statements it will be seen that our present observation upon this field is confined to the following grasses and grass mixtures: —

Kentucky blue-grass.
English rye-grass.
Italian rye-grass.
Red top.
Herds grass.
Meadow fescue.
Kentucky blue-grass and red top.
English rye-grass and red top.
Italian rye-grass and red top.
Red top and herds grass.
Herds grass and meadow fescue.


11 Kentucky Blue Grass.
12 Kentucky Blue Grass.
13 English Rye Grass.
Italian Rye Grass.
14 English Rye Grass and Red Top
15 Herds Grass and Red Top.
16 Italian Rye Grass and Red Top.
17 Meadow Fescue.
18 Meadow Fescue.
19 Herdsgrass.
20 Herdsgrass and Red Top.
21 Meadow Fescue and Red Top.

FIELD "B," 1891.

3. EXPERIMENTS WITH FIELD AND GARDEN CROPS (1891).

Field C.

The area occupied by this piece of land is 328 feet long and 183 feet wide (60,024 square feet). The field is divided into two parts, running from west to east, making thus a north and south division, each 328 feet long and 90 feet wide, with three feet of unoccupied space between them. The soil consists of a good light loam, several feet in thickness. The manure annually applied during preceding years (1884–90) to the entire area consisted of 600 pounds of fine-ground bone and 200 pounds of muriate of potash per acre. The north division had been used for years for the raising of miscellaneous farm and garden crops, for the purpose of studying their adaptation to our clime. Upon the south division during the same period grain and leguminous crops were raised alternately, to serve as fodder.

1891. — Both divisions were ploughed during the preceding autumn, and again in the spring. The *north division* was manured at an early date with bone and potash, as in preceding years, — 600 pounds of fine-ground bone and 200 pounds of muriate of potash per acre. The fertilizer was applied broadcast, and subsequently ploughed in before harrowing and seeding.

The *south division* was subdivided into five plats of a uniform size and shape, with an unoccupied and unmanured space of from four to five feet between adjoining plats. Each plat running across the south division from north to south covered an area of sixty-two by eighty-eight feet. Each plat received a separate distinct mixture of fertilizing substances, to test the effect on the quality and quantity of different kinds of garden crops.

1. North Division, Field and Forage Crops.

The field was prepared and manured as above stated, and served as in preceding years for the cultivation of a variety of field crops. The work was instituted for the purpose of studying the acclimatization of a series of more or less reputed farm plants new to our section of the country, and also to serve as an object lesson to our visitors, regarding their general characteristics. The benefit derived from this practical illustration of our possibilities in the choice of valuable additions to our field crops has been so manifest during preceding years that it will receive increased attention on our part in the future. Some of the plants here cultivated during previous seasons have already been introduced into our farm industry on a sufficiently extensive scale to enable us to form a decided opinion regarding their special local economical value. Foremost among them are some fodder crops, Southern cow-pea, serradella, some vetches, and black and white soja bean. Successful feeding experiments with green vetch and oats and with green soja bean, as well as with a mixed ensilage of soja bean and green fodder corn, have been already noted in our preceding report (eighth). The satisfactory results of preceding years were fully confirmed during the late summer season. A detailed description of this experiment may be found in this report, under the heading, "Summer Feeding Experiment with Milch Cows," page 59.

Statement of crops raised upon the north division of Field C: —

White soja bean (*Soja hispida*), four rows. The seed was raised upon the station grounds in 1890. It was sown in rows three feet and three inches apart, May 18; the young plants appeared above ground May 30, and began to bloom during the middle of July. The lower leaves began to dry up September 4. The crop was pulled to collect the seed September 25.

Black soja bean, four rows. This variety is of a lighter-green color, and seems to be somewhat more vigorous than the former. It is still green when the white variety has turned yellow. We have raised for several years, successfully, large crops of both varieties of soja bean, and consider them for our locality a most valuable addition to our forage crops.

Serradella (*Ornithopus sativus*), eight rows, three feet three inches apart. Sown May 14; began to bloom July 20; appeared somewhat affected by blight September 3, but recovered from this trouble towards the close of September, and was in a healthy condition by October 6. The crop was light, compared with results of previous years; it resisted cold spells to an exceptional degree, being still green October 23. The serradella has furnished us in previous years an exceptionally valuable green fodder, at the rate of from ten to eleven tons of green feed per acre.

Bokhara clover (*Melilotus alba*), four rows, three feet three inches apart. Sown May 23, and had reached a height of over three feet June 16, when it was cut, not yet in bloom. The second growth was much lighter than the first, and was blooming August 7. The plants were not affected by frost October 13. The Bokhara clover furnishes a luxuriant growth, and has a pleasant aromatic odor. It deserves a trial as ensilage, when cut before blooming.

Spring vetch (*Vicia sativa*), four rows, three feet three inches apart. The seed was sown May 14. The young plants appeared above ground May 23, and began to bloom July 2. The crop was cut when beginning to dry, August 17. This plant has a well-established reputation as an excellent fodder crop for dairy purposes. We have for several years raised, very satisfactorily, a mixed crop of vetch and oats, to serve as green fodder for our cows. The yield is liberal, and makes a good hay when properly dried.

Winter vetch, four rows. This variety proved to be somewhat later in blooming, otherwise it showed no particular difference from the former.

Kidney vetch, four rows, two feet apart. The seed was sown May 14; the young plants were noticed above ground May 23. The growth was very slow, the plants measuring only three inches in height September 19. They failed to develop blossoms.

Sainfoin (*Onobrychis sativa*), four rows, three feet three inches apart. Sown May 23, 1890; began blooming May 25. The growth was twenty inches high and almost through blooming when cut, July 17. The second crop was light. Frosts during October did not affect the foliage. Several years' trial shows that the growth is frequently seriously winter-killed.

Yellow trefoil, four rows, three feet three inches apart.

Sown May 14; was up May 27. The growth was very slow, being about four inches high September 19. The first blossoms appeared sparingly October 6. The plants withstood less successfully the October frosts, as compared with some of the previously described crops.

Yellow lupine (*Lupinus lutens*), four rows, three feet three inches apart. Sown May 15; came up May 25. The plants were ten inches high July 14; began blooming when sixteen inches high, July 20. They reached the height of two feet September 18, when an abundance of seed-pods were formed.

White lupine (*Lupinus alba*), four rows, three feet three inches apart. Sown May 15; came up May 23; began to bloom July 4, when twenty-eight inches high. The plants were thirty-eight inches high July 21, and still continued to grow. This crop when in its succulent state (July) has served in preceding years in a superior degree as efficient green manure for winter crops and exhausted grass lands.

Forest pea (*Lathyrus sylvestris*), four rows, two feet six inches apart. Sown May 15; the plants came up sparingly June 10. The growth was very slow, being only four inches high September 19. Frosts did not affect it as late as October 13. This plant is new as a forage crop in Germany and England. Our seed was imported from the latter place, and not the best kind. As it is a biennial plant, another year is needed to form an opinion regarding its economical value.

Common buckwheat (*Fagopyrum esculentum*), four rows, two feet apart. Sown May 14. It began to bloom June 20, and was cut for fodder when the seeds began to set, July 27.

Japanese buckwheat, four rows, two feet apart. Sown May 14; blossomed June 23, and was cut for fodder, like the former variety, July 27. The plants are somewhat more hardy than the common buckwheat.

Silver-hull buckwheat; four rows. Sown May 14; bloomed June 20, and showed a liberal formation of seed-pods July 27, when the crop was cut. A second lot, seeded down June 25, began to bloom July 21, and had finished blossoming August 26. In regard to the weight of the crop harvested, the buckwheats ranked in this order: silver-hull, Japanese, common variety.

Stachys tubers (*Stachys affinis*), little tubers sent on by the Department of Agriculture in Washington, were planted (one row) April 21. They came up May 1; had reached a growth of nine and one-half inches September 19, when suckers came out. Frost did not affect the foliage before October 28. The tubers were left in the ground for observations during the coming year. The tubers are considered a substitute for potatoes in the south of France.

Chinese potato bulblets, sent on for trial as a potato substitute by the United States Department of Agriculture. They were planted April 21, two feet apart in the row; came up May 30, and were from two to three inches high July 14. The plants send out runners from eighteen to twenty inches in length. Leaves suffered from frost October 1. The bulblets were left in the ground for observations during the coming year.

Prickly comfrey (*Symphytum officinale*), one row. The roots for planting were kindly presented by Col. J. D. W. French, and were put in the ground Oct. 11, 1890, two feet apart in the row. They produced a luxuriant growth during the late spring; began to blossom June 5, and reached a height of twenty inches, with numerous highly foliaceous branches. The blossoms were removed, to prevent a seeding out. The plants kept green until the middle of October.

English rye-grass (*Lolium perenne*), three rows. This variety of grass has been raised for a number of years on various fields of the station farm, to ascertain its degree of resistance to the influence of our winter climate. After repeated trials, it is safe to say that it is in an exceptional degree liable to winter-killing in our locality. One-half of the field was winter-killed during the previous winter.

Campbell's spring wheat, three rows, two feet apart. Sown May 4; appeared above ground May 22, and was ripe for cutting August 22. It made a rather light growth.

Winter wheat, twelve varieties, sent on from London, Eng. (Nos. 1–12 below). Each variety occupied five feet in the row, with one foot of space between them. They were sown Sept. 30, 1890. In connection with the English samples were sown two samples of winter wheat sent on by the United States Department of Agriculture (Nos. 13 and 14). Names of varieties: 1. Carter's Millers' Delight; 2. Carter's Stand Up; 3. Carter's Earliest of All; 4. Carter's Anglo-Canadian; 5. Carter's Pride of the Market; 6. Carter's Pearl; 7. Carter's Bird Proof; 8. Carter's Prince of Wales; 9. Carter's Queen; 10. Carter's Hundred Fold; 11. Carter's Flour Ball; 12. Carter's Holborn Wonder; 13. Hybride Dattel; 14. Hybride Larned. No. 4 was badly winter-killed; Nos. 8, 9, 10 and 11 suffered somewhat less from winter-killing; Nos. 1 and 2 were both in good condition. Most of the varieties began to blossom June 21. Nos. 1 and 3 matured first. They were cut July 21. Nos. 2, 5, 7, 8 and 14 were cut August 5, Nos. 6 and 11 were cut August 8, and Nos. 4 and 13 were cut August 12. Our last year's experience with winter wheat has been discouraging, on account of serious damage by frost in all parts of the field.

Kansas king corn, one row. Sown with seed sent on for trial May 20. It was above ground May 30, reached nine feet in height September 19, and was killed by frost October 13, without being matured.

Jerusalem corn, one row, on trial. Sown May 20; appeared above ground May 30; was five inches high July 14; blossomed September 19, when sixty-two inches high, and was killed by frost October 13, when still immature.

Sugar beets, five European varieties. The seeds were received from the United States Department of Agriculture for trial. Five rows of each variety were planted May 20. The young plants were above ground May 27; they were thinned out (from six to eight inches apart) June 22. The crop looked well until the beginning of September, when a brown fungous growth appeared on the leaves. The roots were harvested October 19. They yielded as follows: —

	Pounds.
Florimond Desprez's Richest,	710
Bulteau Desprez's Richest,	690
Dippe's Kleinwanzleben,	600
Dippe's Vilmorin,	620
Simon Le Grand's White Improved,	550

Analysis of Sugar Beet Roots, raised 1891.

VARIETY.	Date of Test.	Average Weight of Beets (Grams).	Moisture at 100° C.	Temperature of Juice.	Degrees, by Brix.	Sugar in Juice, by Fehling's Test (Per Cent.).
Florimond Desprez's Richest,	Dec. 3,	508.06	85.87	18° C.	14.3	13.35
Bulteau Desprez's Richest,	Dec. 2,	498.10	84.54	17° C.	14.4	13.06
Dippe's Kleinwanzleben,	Dec. 2,	463.52	83.59	19° C.	15.2	13.88
Dippe's Vilmorin,	Dec. 1,	522.00	83.75	19.5° C.	15.6	12.54
Simon Le Grand's White Improved,	Dec. 3,	435.22	81.49	20° C.	16.8	15.67

2. *South Division, Garden Crops.*

This part of Field C, 328 feet long and 88 feet wide (28,864 square feet), was subdivided as above stated during the spring of 1891 into five plats of a uniform size and shape (88 feet by 62 feet, one-eighth of an acre), running from north to south across the main field. These were separated from each other by an unmanured space of from four to five feet in width. The soil was several feet deep, and consisted of a rather light loam in a good state of cultivation as far as its mechanical condition is concerned. No other manurial matter but fine-ground bone and muriate of potash, 600 pounds of the former and 200 pounds of the latter per acre, was used before 1891. The field slopes very gently from west to east. The plats were numbered 1, 2, 3, 4, 5, beginning on the east end of the field. Each plat received, spring of 1891, a manurial mixture of its own as fertilizer. The difference of the fertilizers applied consisted essentially in the circumstance that nitrogen and potash were used in several of them in different forms. All plats received practically the same quantity of nitrogen, potash and phosphoric acid, and every one of them received its phosphoric acid addition in the same form, namely, dissolved bone-black. Some plats received their nitrogen supply in the form of organic animal matter, dried blood; others received their nitrogen in the form of sodium nitrate, Chili saltpetre; others in the form of ammonium sulphate. Some plats received their potash in the form of muriate of potash and others in the form of the highest grade of potassium sulphate (in our market 95 per cent. purity). The subsequent tabular statement shows the quantities of the manurial substances applied to different plats: —

Plat 1, . . .	75 pounds dried blood. 30 pounds muriate of potash. 40 pounds dissolved bone-black.
Plat 2, . . .	47 pounds nitrate of soda. 30 pounds muriate of potash. 40 pounds dissolved bone-black.
Plat 3, . . .	38 pounds sulphate of ammonia. 30 pounds muriate of potash. 40 pounds dissolved bone-black.
Plat 4, . . .	47 pounds nitrate of soda. 30 pounds high-grade sulphate of potash. 40 pounds dissolved bone-black.
Plat 5, . . .	38 pounds sulphate of ammonia. 30 pounds high-grade sulphate of potash. 40 pounds dissolved bone-black.

		Pounds.
Per acre:	Phosphoric acid, ...	50.4
	Nitrogen, ...	60.0
	Potassium oxide, ...	120.0

The different fertilizers were applied broadcast, and subsequently slightly ploughed under in all cases on the same day (April 22, 1891). All plats were planted in the same order with the same kind of garden crops (eight). Every plat was either planted with young plants or was sown with the seed, as circumstances dictated, each kind on the same day and in the same manner. The young plants used for the experiment were raised under corresponding conditions from seed in the hot-bed. The seeds used were in several cases sent on for trial. The different kinds of garden crops were arranged in the following order, beginning on the east side of each plat: —

Lettuce, White Tennis Ball, one row.
Spinach, Long Standing and Bloomingdale, one row each.
Beets, Egyptian and Dewings, one row each, or two of a kind.
Celery, White Plume, one row.
Kohlrabi, two rows.
Cabbage, Red Dutch and several white varieties, three rows in all.
Tomatoes, Boston Market, two rows.
Potatoes, Beauty of Hebron, five rows.

Spinach, beets and potatoes were raised from seeds upon the different plats. Lettuce, celery, kohlrabi, cabbage and tomatoes were sown in a hot-bed and subsequently transferred when of suitable size, each kind for all plats on the same day, as will be found farther on. All crops were kept clean during the growing season by a timely use of the cultivator and the hoe.

Lettuce, White Tennis Ball, set out May 1. The growth was in the beginning slow, on account of cold and dry weather, but subsequently recovered rapidly and produced a good yield, judging from the general appearance of the crop. Plats 4 and 5 produced the best results, Plat 2 came next and plats 1 and 3 last.

Spinach, sown May 1. Bloomingdale grew more rapidly than Long Standing. Plats 4 and 5 gave best results, Plat 2 next and plats 1 and 3 last.

Beets, Dewings and Egyptian, each one row, sown May 21. The young plants appeared above ground June 1; they were thinned out July 11 and harvested October 17, with the following results, Plat 4 leading: —

Plats.	Dewings.	Egyptian.	Total.
	Pounds.	Pounds.	Pounds.
Plat 1, ...	225	140	365
Plat 2, ...	240	155	395
Plat 3, ...	240	180	420
Plat 4, ...	245	240	485
Plat 5, ...	220	190	410

Celery, White Plume, one row, set out June 1. The plants were banked August 20; they were taken out October 28. Plats 4 and 5 showed best and plats 2 and 3 worst.

Kohlrabi, two rows, planted with young plants from the hot-bed May 18; they were harvested July 16, with the following results: —

	Pounds.
Plat 1,	105
Plat 2,	120
Plat 3,	115
Plat 4,	145
Plat 5,	152

Cabbage, Red Dutch in all plats, varieties of other kinds only here and there in different plats. Judging from the general appearance of the crop, it seemed that plats 1, 2 and 3 were leading. On the whole the yield was quite satisfactory. No weights were taken, on account of the different varieties in the plats.

Tomatoes, Boston Market, two rows, set out May 30. Plats 2 and 3 showed the poorest development of the plants; they had the first few ripened tomatoes August 5. The following weights of ripe and healthy tomatoes were collected from different plats during the season: —

DATE.	PLATS				
	1	2	3	4	5
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
August 25,	67.0	44.0	92.5	124.0	118.0
August 31,	65.0	11.5	63.0	211.0	257.0
September 8,	67.0	30.5	95.0	211.0	168.0
September 17,	99.5	65.0	84.0	101.5	98.0
Total,	298.5	150.0	334.5	647.5	641.0

Potatoes, Beauty of Hebron, five rows, were planted in each plat May 1. The rows were three feet three inches apart and the hills two feet apart in the row. The young plants appeared above ground quite uniformly May 21.

The vines in all plats looked healthy throughout the season; they began to turn yellow first on Plat 2. The potatoes on all plats were harvested August 11 and 12, when the leaves were dead but the stems still green. They were smooth and free from scab. The different plats yielded the following weights of large, marketable potatoes and of small potatoes: —

PLATS.	Large Potatoes.	Small Potatoes.	Total.
	Pounds.	Pounds.	Pounds.
Plat 1, ...	540	130	670
Plat 2, ...	550	110	660
Plat 3, ...	660	90	750
Plat 4, ...	670	110	780
Plat 5, ...	620	115	735
	3,040	555	3,595

This experiment will be continued during the coming season with the same crops and with the same mixtures of fertilizing ingredients, making such alterations as the experience of the past season suggests. The results of the first year are above presented without any further comment.

A critical discussion of the results is deferred to a later period in our investigation, when the experience of several years will furnish a safer basis for deduction.

4. Experiments with Stowell's Evergreen Sweet Corn for Ensilage (1891).

Field D.

The area occupied by this field is 328 feet long and 70 feet wide (22,960 square feet, or .53 of an acre). It runs parallel with Field C from east to west, and is separated from the latter by an unmanured strip of grass land 20 feet wide. The land has served in previous years for various field and garden crops, and was manured annually for several years back with 600 pounds of fine-ground bone and 200 pounds of muriate of potash per acre. The soil consists of a light loam, is fairly uniform and several feet in depth. It was ploughed during the autumn of 1890 and reploughed April 17, 1891. The same amount of fine-ground bone and muriate of potash as in preceding years was applied broadcast April 24 (315 pounds of the former and 105 pounds of the latter).

The entire field was planted May 2 with Stowell's Evergreen sweet corn; the seed did not come up very satisfactorily.

New seed corn was planted May 25 with good success; yet the crop remained late throughout the season. The crop with ears well developed, kernels in the milk, was cut for ensilage September 10. The total yield amounted to 17,800 pounds, or 16.9 tons per acre.

The whole plant was cut into pieces of from one to two inches in length, and without delay carefully packed into a silo in a way similar to that described in previous reports. The ensilage is designed to serve during the present winter season in feeding experiments, to compare its merits with ensilage prepared from a dent corn variety, Pride of the North, raised under similar conditions and of a corresponding state of maturity.

Field E.

This field was divided during the past year into two parts. The larger part was manured and planted in the same manner as Field D, with Stowell's Evergreen. The remainder was sown with several species of medicinal plants sent on for trial by the United States Department of Agriculture. The corn proved a success, and after being fully matured was cut. The ripe air-dry ears were subsequently collected; they weighed 729 pounds. The air-dry stover (2,520 pounds) served for a comparative feeding experiment with milch cows.

The majority of the seeds of the medicinal plants proved a failure. Opium poppy (*P. somnifera*), Russian rhubarb (*Rheum officinale*) and castor bean (*Ricinus communis*) did well.

Fodder Corn (Stowell's Evergreen), Station, Field D.
(Cut Sept. 10, 1891.)

	Per Cent.
Moisture at 100° C.,	83.91
Dry matter,	16.09
	100.00

Analysis of Dry Matter.

Crude ash,	6.73
" cellulose,	26.03
" fat,	3.26
" protein (nitrogenous matter),	8.09
Non-nitrogenous extract matter,	55.89
	100.00

5. Experiments to study the Economy of using Different Commercial Sources of Phosphoric Acid for Manurial Purposes in Farm Practice.

Field F.

The field selected for this purpose is 300 feet long and 137 feet wide, running on a level from east to west. Previous to 1887 it was used as a meadow, which was well worn out at that time, yielding but a scanty crop of English hay. During the autumn of 1887 the sod was turned under, and left in that state over winter. It was decided to prepare the field for special experiments with phosphoric acid by a systematic exhaustion of its inherent resources of plant food. For this reason no manurial matter of any description was applied during the years 1887, 1888 and 1889.

The soil, a fair sandy loam, was carefully prepared every year by ploughing during the fall and in the spring, to improve its mechanical condition to the full extent of existing circumstances. During the same period a crop was raised every year. These crops were selected, as far as practicable, with a view to exhaust the supply of phosphoric acid in particular. Corn, Hungarian grass and leguminous crops (cow-pea, vetch and serradella), followed each other in the order stated.

1890. — The land had been ploughed during the preceding fall, and again April 19, 1890. The field was subdivided subsequently into five plats of definite size, each running from east to west. These plats were separated from each other by a space eight feet wide.

The plats and spaces between them were ploughed and harrowed alike. The plats were fertilized at stated times; the spaces which separated them received at no time any kind of manurial matter.

The manurial material applied to each of these five plats contained, in every instance, the same form and the same quantity of potassium and of nitrogen, while the phosphoric acid was furnished in each case in the form of a different commercial phosphoric-acid-containing article; namely, phosphatic slag, Mona guano, apatite, South Carolina phosphate (floats), and dissolved bone-black. The market cost of each of these articles controlled the quantity applied, for each plat received the same money value, in its particular kind of phosphate.

	Cost per Ton.
Phosphatic slag,	$15 00
Mona guano (West Indies),	15 00
Ground apatite (Canada),	6 25
South Carolina phosphate (floats),	15 00
Dissolved bone-black,	25 00

Analyses of Phosphates used.

[I. Phosphatic slag; II. Mona guano; III. Apatite; IV. South Carolina phosphate (floats); V. Dissolved bone-black.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	0.47	12.52	0.09	0.39	15.96
Ash,	–	75.99	–	–	61.46
Calcium oxide,	46.47	37.49	–	46.76	–
Magnesium oxide,	5.05	–	–	–	–
Ferric and aluminic oxides,	14.35	–	–	5.78	–
Total phosphoric acid,	19.04	21.88	36.08	27.57	15.82
Soluble phosphoric acid,	–	0.00	–	0.00	12.65
Reverted phosphoric acid,	–	7.55	–	4.27	2.52
Insoluble phosphoric acid,	–	14.33	–	23.30	0.65
Insoluble matter,	4.39	2.45	9.55	9.04	6.26

The following fertilizers were applied to the different plats April 17, 1890: —

Plat I. (south side), 6,494 square feet,	127 pounds of ground phosphatic slag. 43 pounds of nitrate of soda. 58 pounds of potash-magnesia sulphate.
Plat II., 6,565 square feet,	128 pounds of ground Mona guano. 43½ pounds of nitrate of soda. 59 pounds of potash-magnesia sulphate.

Plat III., 6,636 square feet, .	304 pounds of ground apatite. 44 pounds of nitrate of soda. 59 pounds of potash-magnesia sulphate.
Plat IV., 6,707 square feet, .	131 pounds of South Carolina phosphate. $44\frac{1}{2}$ pounds of nitrate of soda. 60 pounds of potash-magnesia sulphate.
Plat V., 6,778 square feet, .	78 pounds of dissolved bone-black. 45 pounds of nitrate of soda. 61 pounds of potash-magnesia sulphate.

The phosphatic slag, Mona guano and South Carolina floats were applied at the rate of 850 pounds per acre, apatite at the rate of 2,000 pounds per acre; dissolved bone-black at the rate of 500 pounds per acre. These figures represent approximately the equal local cash values of the different sources of phosphoric acid applied. Nitrate of soda corresponds in all cases to an application of 290 pounds per acre, and the potash-magnesia sulphate to that of 390 pounds per acre.

The field was planted with potatoes, Beauty of Hebron; the large-sized ones were cut in halves, and the small ones left whole, when planted, May 1, 1890. The rows were three feet three inches apart, and the hills in the rows eighteen inches. Each plat had sixteen rows. The young plants came up quite uniformly; they were cultivated and hoed June 2. Several applications of Paris green with plaster were made during the season, to prevent damage by potato bugs. The crop looked well until the middle of July, when the effects of a serious drought showed itself to such an extent that the maturing seemed to be hastened on by it.

The potatoes were harvested from all the plats August 12 to 14. They were assorted in the field into marketable ones and small ones. The former were sold at sixty cents per bushel; the latter were used for chicken feed, at twenty cents per bushel, — our local market prices.

No. of Plat.	Total Yield of Potatoes (Pounds).	Marketable Potatoes (Pounds)	Small Potatoes (Pounds)
I. (south end),	1,600	1,215	385
II.,	1,415	915	500
III.,	1,500	1,070	430
IV.,	1,830	1,380	450
V. (west end),	2,120	1,590	530

Yield per Acre.

I. Phosphatic slag,	10,671	8,087	2,584
II. Mona guano,	9,388	6,071	3,317
III. Ground apatite,	9,845	7,023	2,822
IV. South Carolina phosphate,	11,886	8,963	2,923
V. Dissolved bone-black,	13,626	10,218	3,408

Statement of Percentages.

Plats.	Marketable Potatoes (Per Cent).	Small Potatoes (Per Cent).
I.,	75.78	24.22
II.,	64.66	35.34
III.,	71.32	28.68
IV.,	75.40	24.60
V.,	74.91	25.09

Money Value of Crop.

[One bushel = 60 pounds.]

Plat.	Marketable Potatoes, at 60 Cents per Bushel.	Small Potatoes, at 20 Cents per Bushel.	Total Sum.
I.,	134.6 bushels = $80 76	43.0 bushels = $8 60	$89 36
II.,	101.2 bushels = 60 72	55.3 bushels = 11 06	71 78
III.,	117.1 bushels = 70 26	47.1 bushels = 9 42	79 68
IV.,	149.3 bushels = 89 58	48.7 bushels = 9 74	99 32
V.,	170.3 bushels = 102 18	56.8 bushels = 11 36	113 54

As a first year's results, the above statements were published without any further comment beyond the remark that the exceptional dryness of the season might have favored a superior action of the soluble phosphoric acid as compared with the insoluble one. Attention was also called to the important circumstance that an accumulation of phosphoric acid in the soil might eventually affect the results as time advances. The largest yield of potatoes had only removed 3.4 pounds of phosphoric acid from the soil.

Plat I. received	24.18	pounds of phosphoric acid.
Plat II. received	28.01	pounds of phosphoric acid.
Plat III. received	109.68	pounds of phosphoric acid.
Plat IV. received	36.12	pounds of phosphoric acid.
Plat V. received	12.34	pounds of phosphoric acid.

Tabular Statement of the Approximate Amount of Nitrogen, Phosphoric Acid and Potash in the Crop raised.

PLATS.	Pounds of Potatoes per Plat.	Pounds of Nitrogen in Tubers.	Pounds of Phosphoric Acid in Tubers.	Pounds of Potassium Oxide in Tubers.
I.,	1,600	5.440	2.560	9.280
II.,	1,415	4.811	2.364	8.207
III.,	1,500	5.100	2.400	8.700
IV.,	1,830	6.222	2.928	10.614
V.,	2,120	7.208	3.392	12.296

The calculation is based on E. Wolff's average analyses, 1,000 pounds of potatoes containing: nitrogen, 3.4 pounds; phosphoric acid, 1.6 pounds; and potassium oxide, 5.8 pounds.

1891. — The experiment was continued by selecting winter wheat as the next crop to be raised. For this purpose the soil was ploughed soon after the potatoes had been harvested, and subsequently manured and harrowed, as in case of the preceding crop. The change in the mode of manuring the different plats was confined to Plat III., which received no ground apatite, for the reason that none could be obtained from the party that furnished our first supply of this article. No other form of phosphoric acid was substituted.

The following table shows the kind and amount of fertilizers applied to the plats: —

Plat I. (south side), 6,494 square feet,	127 pounds of ground phosphatic slag. 43 pounds of nitrate of soda 58 pounds of potash-magnesia sulphate.
Plat II, 6,565 square feet,	128 pounds of ground Mona guano. 43½ pounds of nitrate of soda 59 pounds of potash-magnesia sulphate.
Plat III., 6,636 square feet,	44 pounds of nitrate of soda. 59 pounds of potash-magnesia sulphate.
Plat IV., 6,707 square feet,	131 pounds of South Carolina phosphate. 44½ pounds of nitrate of soda. 60 pounds of potash-magnesia sulphate.
Plat V., 6,778 square feet,	78 pounds of dissolved bone-black. 45 pounds of nitrate of soda 61 pounds of potash-magnesia sulphate.

The wheat — two new French varieties of winter wheat, Hybrid Dattel and Hybrid Larned, sent on for trial by the United States Department of Agriculture — was sown Sept. 26, 1890. The young plants came up well, but were found winter-killed in the succeeding spring. The entire field was reploughed and seeded down with summer wheat in rows two feet apart May 11, 1891. The seed proved good and the crop did well during the entire season. A marked difference in the general character of the growth upon different plats could be noticed as the season advanced. Plats I. and V. were leading throughout the season, while Plat III. was least promising and matured last.

Following is a statement showing the height of the crop on the different plats at different periods of the season: —

PLATS.	June 16 (Inches).	June 23 (Inches).	June 30 (Inches).	July 7 (Inches).	July 14 (Inches).	July 21 (Inches).	Aug. 11 (Inches).
Plat I.,	12	20	29	31	46	48	48
Plat II.,	11	18	25	29	40	42	42
Plat III.,	7	11	17	22	28	34	34
Plat IV.,	12	18	25	29	41	45	45
Plat V.,	12	20	27	31	47	48	48

The crop upon plats I., II., IV. and V. was cut August 14, and that on Plat III. August 18. The entire yield was moved into the barn August 20, where it remained stored until September 25, when the product of each plat was weighed and threshed, with the following results: —

PLATS.	Grain and Straw (Pounds).	Grain (Pounds).	Straw and Chaff (Pounds).	Percentage of Grain.	Percentage of Straw and Chaff.
Plat I, . . .	380	67	313	17.63	82.37
Plat II., . . .	340	73	267	21.47	78.53
Plat III., . . .	215	38	177	17.67	82.33
Plat IV., . . .	380	78	302	20.53	79.47
Plat V., . . .	405	59	346	14.57	85.43
	1,720	315	1,405		

An examination of the above tables shows that the total yield of wheat was highest upon Plat V., and lowest upon Plat III. The larger yield of Plat V. (dissolved bone-black) is in an exceptional degree due to the large production of straw and chaff, as compared with that of the grain. Plats II. (Mona guano) and IV. (South Carolina phosphate) yield the largest percentage of grain.

6. EXPERIMENTS WITH A WESTERN VARIETY OF DENT CORN, PRIDE OF THE NORTH, FOR ENSILAGE.

Field G.

This field is a part of a former meadow. Grass has been raised here for more than fifteen years in succession. A moderate top-dressing of barn-yard manure has kept the land in a fair condition for the production of hay. Eight years ago a row of drain pipes four inches in diameter was laid along its whole length. Branch drains pass into it in several places, to prevent the accumulation of water from surrounding localities. The land is nearly a level, and the soil a loam several feet in depth, here and there underlaid with a hardened clay. The area is 700 feet long and 75 feet wide, running from north to south to the east of Field A. During the fall of 1890 the sod was turned under and left over winter to disintegrate. During the late spring the soil was again ploughed and the remaining sod cut up with a wheel harrow. After subsequent harrowing it was planted May 13 with a dent corn variety, Pride of the North, in rows three feet three inches apart, the hills being two feet apart in the row. No manure was applied on that occasion, the object being to reduce the stored-up plant food, and thereby prepare the soil for future field experiments with special fertilizers.

The young plants came up well and made a handsome growth. At the time when the kernels began to glaze ten and two-thirds tons were cut to be converted into ensilage September 10. The remainder of the crop was cut September 16, to secure matured ears and corn stover. The air-dried stover thus obtained weighed, October 19, 4,185 pounds, and the ears 2,500 pounds.

The area used for ensilage corn, 25,650 square feet, yielded at the rate of eighteen tons and three hundred pounds per acre. The area turned to account for ears and stover, 26,850 square feet, produced at the rate of 4,056 pounds of ears and 6,782 pounds of stover per acre.

Fodder Corn (Pride of the North), Station, Field G.
(Cut Sept. 10, 1891.)

	Per Cent.
Moisture at 100° C.,	71.86
Dry matter,	28.14
	100.00

Analysis of Dry Matter.

Crude ash,	3.78
" cellulose,	25.67
" fat,	2.24
" protein (nitrogenous matter),	7.62
Non-nitrogenous extract matter,	60.69
	100.00

7. EXPERIMENTS WITH GRASS LAND (MEADOWS).

The permanent grass lands are by their location arranged into two divisions, west and east of a public highway. They cover at present a space of sixteen to seventeen acres.

The *west side division* consists of old meadows, kept for over twenty years in grass. The area has for years been steadily reduced in size by turning, as circumstances advised, more or less at a time into plats for field experiments. In their present condition they surround our main field for experimental purposes. They are in part underdrained, and are kept, by a moderate annual top-dressing with barnyard manure, in a fair state of production, considering the condition of the sod. The area comprises to-day approximately not more than seven acres. Thirteen tons of hay, first cut, and two and three-quarters tons of rowen, hay of second cut, was the yield in 1891.

The *east side division* of meadows comprises an area of about 9.6 acres. The entire field to 1886 consisted of old, worn-out grass lands, overrun with a worthless growth on its more elevated portion, and covered with weeds and sedges in its lower section. The improvement of the land by underdraining and ploughing, and subsequently by the use of a system of drill culture, began in some parts (north end) in 1886, and in others (south end) in 1887. For the details of this work, as well as of the subsequent seeding down into permanent grass land, I have to refer to preceding annual reports.

It will suffice, for the appreciation of the present yield of these new meadows, to call attention once more to the following circumstances.

1886. — As soon as the drain tiles were covered and the ditches as far as practicable levelled, the entire area was ploughed, and the main depressions filled up with stones and earth, or earth, as circumstances advised, and left in that condition over winter.

1887. — The succeeding spring a wheel harrow was used to break up the rotten sod. The soil was subsequently repeatedly ploughed and harrowed, until it showed the desirable mechanical condition required for a successful cultivation of summer grain crops.

Barley and oats were chosen as the first crops in case of the meadow north of the new roadway. Both were seeded in drills, with rows two feet apart, to permit a thorough destruction of an objectionable foul growth by a frequent use of the cultivator and hoe.

As soon as these crops were harvested, one ton of wood ashes per acre was ploughed in, to assist in the disintegration of the excess of organic peaty matter, and to serve as a general fertilizer. Ploughing once more and smoothing the surface by means of a brush harrow, the entire area was seeded down into grass to serve as meadow. The latter was subsequently cut into two, by a road built for communication to more remote fields. This arrangement caused a division into a northern and southern meadow.

1888. — In case of the land south of the roadway, leguminous plants, as soja bean, Southern cow-pea and serradella, served as first crop. The system of drainage and of seeding down remained the same as before. The meadow north of the road covers an area of somewhat more than six acres, and that south of the road is about three acres in size. The meadow north of the road was sown for the first time in the fall of 1887, with grass, and the one south of the roadway in the fall of 1888.

The more elevated portions of both were seeded down with the following mixture of grass seeds, at the rate of from two to two and one-half bushels per acre: —

Two bushels herds grass (*Phleum pratense*).
Two bushels red top (*Agrostis vulgaris*).
Two bushels Kentucky blue-grass (*Poa pratensis*).
Two bushels meadow fescue (*Festuca pratensis*).
Seven pounds sweet-scented vernal grass (*Anthoxanthum odoratum*).

Early in the succeeding spring a mixture of equal weights of medium red clover and alsike clover was added broadcast, at the rate of from five to six pounds per acre.

The lower and still more wet portion of the meadow was seeded down with the following mixture of grass seeds: —

Twenty pounds of soft brome grass (*Bromus mollis*).
Twelve pounds herds grass (*Phleum pratense*).
Nine pounds red fescue (*Festuca rubra*).
Eight pounds fowl meadow grass (*Poa serotina*).
Seven pounds Rhode Island bent (*Agrostis alba*).
Six pounds orchard grass (*Dactylis glomerata*).
Five pounds crested dog-tail (*Cynosurus cristatus*).
Four pounds meadow soft grass (*Holcus lanatus*).
Two pounds sweet-scented vernal grass (*Anthoxanthum odoratum*).

1889. — From four to five pounds of alsike clover per acre were added by broadcast seeding early in the succeeding spring (1889).

The seed came up well, and suffered but here and there in wet spots during the first winter. Barren spots were reseeded.

Both meadows were cut but once during the first summer season, somewhat later than usual; the majority of grasses did not, as might be expected, head out.

As soon as the first crop of hay was secured, a system of manuring was planned, which would illustrate the comparative manurial effect of top-dressing, as follows: —

By barn-yard manure
By ground bones and muriate of potash.
By unleached wood ashes.

The northern meadow, consisting of six and one-half acres, was subdivided into three plats, I., II., III., running from east to west, leaving a space of twenty feet in width between them without any manurial matter.

The southern meadow was divided into two plats, IV., V. (south end). Plats I., II., III. were sown down in grass during September, 1887, and plats IV. and V. during September, 1888. The subsequent stated system of manuring began in the autumn of 1888, on all plats at the same time.

Plat I. (north end of the field) is equal to 1.92 acres. It was top-dressed during the fall and early spring with barn-yard manure, at the rate of eighteen tons per acre (1888–89).

Plat II. covers a similar area to Plat I. (83,640 square feet). It received at the same time a top-dressing of barn-yard manure, at the rate of eight tons per acre (1888).

The coarsest part of the barn-yard manure was subsequently removed from both plats before the growing grass interfered with its being raked off.

Plat III., about 2.41 acres, received, May 3, 1889, a top-dressing of six hundred pounds of fine-ground steamed bone and two hundred pounds of muriate of potash per acre.

Plat IV. (south of roadway), an area of 2.11 acres, received the same dressing, in the same proportion and at the same rate (six hundred pounds ground bone and two hundred pounds muriate of potash) per acre as Plat III. (1889).

Plat V., equal to .91 acres, received, as top-dressing, April 23, 1889, one ton of unleached Canada wood ashes, from our local market (1889).

Yield of Hay in Case of Plats I., II. and III. (Second Year after Seeding), and of Plats IV. and V. (First Year after Seeding).

Plat I.	First Cut.	Second Cut.
1.92 acres, . .	10,500 pounds, June 24.	4,370 pounds, August 26.
Total yield per acre, 7,745 pounds, or 3.87 tons.		

Plat II.	First Cut.	Second Cut.
1.92 acres, . .	9,130 pounds, June 24.	4,650 pounds, August 26.
Total yield per acre, 7,177 pounds, or 3.59 tons.		

Plat III.	First Cut.	Second Cut.
2.41 acres, . .	12,200 pounds, June 24.	4,950 pounds, August 26.
Total yield per acre, 7,116 pounds, or 3.56 tons.		

Plat IV. (2.11 acres); Plat V. (.91 acres): The first year's hay consisted nearly entirely of herds grass, which was almost the only variety which had headed out in June. The yields of both plats were harvested together.

First Cut.	Second Cut.	Total Yield per Acre.
8,130 pounds, June 24.	3,105 pounds, August 31.	3,720 pounds, or 1.86 tons.

1890. — The different plats were prepared in a similar manner for the season of 1890 as they had been for the preceding season, 1889.

Plats I. and II. received a top-dressing of barn-yard manure during the months of October and November: the former at the rate of fourteen tons per acre, and the latter at the rate of eleven tons.

Plat III. was treated in April, 1890, as before, with a mixture of six hundred pounds of fine-ground bones and two hundred pounds of muriate of potash.

Plats IV. and V. were merged into one plat, and received a top-dressing of unleached wood ashes, at the rate of one ton per acre, April 19, 1890.

Barren spots in this plat, it being the second year after seeding down, were reseeded by the same seed mixture which had been used before.

The entire meadow received an addition of from two to three pounds of alsike clover seed, broadcast, per acre.

All plats were cut as far as practicable at the same time.

Yield of Hay in 1890.

Plat I.	First Cut.	Second Cut.
1.92 acres, . .	14,625 pounds, July 1.	3,790 pounds, Sept. 1.
Total yield of hay, 18,415 pounds. Yield per acre, 9,591 pounds, or 4.80 tons.		

Yield of Hay in 1890 — Concluded.

PLAT II.	First Cut.	Second Cut.
1.92 acres, . .	12,480 pounds, July 1.	3,105 pounds, Sept 3.

Total yield of hay, 15,585 pounds.
Yield per acre, 8,117 pounds, or 4.06 tons.

PLAT III.	First Cut.	Second Cut.
2.41 acres, . .	14,460 pounds, June 26.	3,535 pounds, September.

Total yield of hay, 17,995 pounds.
Yield per acre, 7,466 pounds, or 3.73 tons.

PLAT IV. (IV. and V., **1889.**)	First Cut.	Second Cut.
3 acres, . . .	13,380 pounds, July 1.	4,080 pounds, Sept 3.

Total yield of hay, 17,460 pounds.
Yield per acre, 5,820 pounds, or 2.91 tons.

The total yield of hay on plats I., II. and III. averages 4.19 tons per acre. The total yield on Plat IV. averages 2.91 tons per acre.

The weight of the second cut of hay (rowen) averages about one-fourth of that of the first cut. The dryness of the season during the latter part of July affected seriously the yield of the second cut. The wet season of 1889, as compared with the dry season of 1890, as well as the difference in the age of the two meadows, renders further comparison not advisable at this early stage of our investigation.

1891. — The same system of manuring the different plats was adopted as in the preceding years; some reduction, however, was made, with reference to the quantity of barn-yard manure applied per acre to plats I. and II., to ascertain the limit of its usefulness. Plat I. was top-dressed with barn-yard manure at the rate of 8 tons and Plat II. at the rate of 6 tons per acre. Plat III. received, as in previous years, as top-dressing 600 pounds of fine-ground bone and 200 pounds of muriate of potash per acre. The barn-yard manure was applied during the autumn and winter; the bone and potash early in the spring. Plat IV. received, as before, a top-dressing of wood ashes at the rate of 1 ton per acre early during the spring.

All plats were cut as far as practicable at the same time, with the following results: —

Yield of Hay for the Year 1891.

PLATS.	First Cut.	Second Cut.
	Pounds.	Pounds.
Plat I, per acre,	6,528	1,446
Plat II, per acre,	5,988	1,440
Plat III, per acre,	4,641	1,015
Plat IV., per acre,	3,750	1,610

The dry season has evidently seriously reduced the yield, as compared with the preceding year.

8. REPORT ON GENERAL FARM WORK (1891).

Aside from the farm work connected with the different field experiments previously described, much has been accomplished in other directions.

Considerable progress has been made in perfecting the arrangement for a system of co-operative work in the vegetation house and upon the experimental plats in the field.

The new orchard for testing the influence of different systems of fertilization on the health and general condition of fruit trees has received the needed attention. More young trees have been planted, and suitable crops have been raised over the entire area to economize the ground while the trees are still small.

Some reputed fodder crops comparatively new to our locality have been raised on a sufficiently large scale to serve for feeding experiments. Most prominent among them are a mixed crop of spring vetch and oats, and soja bean, both for green fodder.

Several acres have been planted with oats, barley and Indian corn, besides some varieties of roots and potatoes to furnish fodder for our farm live-stock.

Two silos are filled, one with Stowell's Evergreen sweet corn and the other with a dent corn, Pride of the North, to compare their feeding value as well as their general economical merits under fairly corresponding conditions.

A new barn has been built, to allow a proper separation of the crops obtained in connection with different field experiments.

A liberal production of fodder crops for the support of the farm live-stock has been for economical reasons a leading object in the management of the farm.

The improvement of the general condition of the various parts of the farm, wherever circumstances admitted a free choice of means, has received at all times deserved attention.

The following statement is an enumeration of the principal crops raised on different parts of the farm, on lands either permanently assigned for the production of fodder for the live stock of the station or undergoing a course of preparation for future experiments.

	Tons.
Hay (first cut),	38½
Rowen (second cut),	10½
Fodder corn (green),	22
Corn stover (dry),	4
Roots (sugar beets, 2½; carrots, 1½; mangolds, 3 tons),	7
Rye (1,303 pounds grain, 3,572 pounds straw),	2¼
Barley (1,838 pounds grain, 3,647 pounds straw),	2¼
Oats (2,094 pounds grain, 5,532 pounds straw),	3¾
Wheat (315 pounds grain, 1,405 pounds straw),	⅘
Potatoes,	1⅘
Vetch and oats (green),	5⅓
Soja bean (green),	4⅓
Miscellaneous crops,	2

9. DEPARTMENT OF VEGETABLE PHYSIOLOGY.

REPORT BY PROF. JAS. ELLIS HUMPHREY.

During the past year the work of this department has gone on steadily, and with some interesting results. According to the plan indicated in our last report, the chief subjects of investigation during the winter and spring have been certain diseases of winter crops under glass. It is proposed to continue this line of work in the study of other such diseases, both because the equipment of the station affords facilities for such work, and because the extent of the green-house interest in Massachusetts renders such investigations appropriate and desirable. The writer will be glad to communicate with any person who suffers from any disease of plants grown under glass, and to receive diseased plants for study, as well as to render any service in his power to losers by open-air diseases in summer.

A very decided gain has been observable during the year in the importance and amount of the correspondence of the department and in the promptness and fulness with which inquiries addressed to persons who could furnish practical information to the department have been answered. This is gratifying, because it indicates that the efforts of the station to advance knowledge and disseminate information in the field of vegetable pathology, as well as in other lines in which its work has been longer established, are coming to be appreciated. As in the past, all correspondence will receive prompt attention.

The details of the year's work here reported are grouped under the following heads: —

1. The Rotting of Lettuce.
2. The Powdery Mildew of the Cucumber.
3. Various Diseases.
4. Preventive Treatment.
    a. In Genearl.
    b. For Smuts.

As heretofore, reference to the "General Account of the Fungi," in the seventh report of this station, will be found helpful to an understanding of these discussions.

THE ROTTING OF LETTUCE. — *Botrytis vulgaris* Fr.*

Gardeners who cultivate lettuce as a winter crop usually suffer somewhat and often lose extensively by the rotting of the plant while still only partially grown. The trouble ordinarily appears first upon the stem of the plant, about at the surface of the soil. Here may be seen at first a soft, dark, decayed spot, which rapidly spreads, penetrating the stem and involving next the bases of the lower leaves. The latter, being thus cut off from the plant by the decay of their bases, usually dry up. With the further progress of the decay, the centre of the head, with the tender inner leaves, becomes attacked, and soon collapses into a fetid, slimy mass. In the decaying tissues one can often recognize fungus threads; and, if they are left undisturbed, there appear on the decayed remains the fruiting threads and spores of a fungus, always the same. When portions of the attacked tissues are removed and placed in a moist chamber after being thoroughly washed, I have found that the same fungus develops promptly and abundantly, and is never accompanied by any other. The study of specimens from various sources has led always to the same result.

Infection experiments with the fungus on healthy plants have been attended with little success; but the most that can be said is that their results indicate that the fungus requires for its attack conditions not yet determined. They do not negative the very strong evidence furnished by the constant association of the fungus with the decay. These experiments have not been carried so far as is desirable, on account of a lack of sufficient suitable material, and further cultures which I hope to make this winter may show that we have here a case similar to that described by DeBary,† in which the fungus threads require to be nourished saprophytically for a time before they can gain sufficient vigor to enable them to attack and live parasitically upon their host.

The fungus in question is one of the imperfect forms known as *Botrytis* or *Polyactis*, and agrees in many respects with that described by Marshall Ward* as causing a disease of garden lilies. It appears to be able to live saprophytically upon decaying vegetable substances, and is often found upon them; but I have never been able to detect any traces of decay in lettuce in a house where the fungus was not abundantly to be found. These facts point to the conclusion that this *Botrytis* is the *cause* of the rotting, and not merely an accompaniment of decay due to some other cause. It seems doubtful, however, if the affection can be called a disease in the sense that the fungus is able to attack perfectly sound, healthy lettuce under ordinary conditions. I have never seen the decay begin elsewhere than at the lower part of the stem; and it is possible that some injury or imperfection at that place is necessary to furnish a point of attack.

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* Two plates which had been prepared to illustrate the first two articles of this report, and delivered to the lithographer, were unaccountably lost in the mail before their engraving had been completed. It was impossible to duplicate the drawings in season for this report, but they will be prepared and published as soon as practicable.

† Botan Zeitung, 1886, Nos. 22–27.

The structure of the fungus is very simple. From the creeping vegetative threads arise the erect spore-bearing ones, which branch sparingly toward their tips. The ends of the branches become slightly swollen, and from each is developed a number of short, peg-like projections. Each of these now begins to swell at its tip into a globular body, which increases in size and finally becomes elliptical in form. This is the spore, which, when ripe, falls from its attachment. The spores germinate promptly in water or a nutrient solution, by pushing out one or more threads each. These threads, when supplied with nourishment, grow rapidly into a much-branched mycelium. In a few days the erect spore-bearing threads begin again to be formed, as above described. Well-nourished specimens growing in a moist atmosphere may, after the first spore cluster has been formed, put out a new branch from the fertile thread, just below the cluster of spores. This thread then grows to a considerable length and then develops at its tip a new spore cluster; and this process may be several times repeated. The result of such a course of development is to produce what appear to be very long, fertile threads, with spore clusters scattered at intervals along them.

Instead of a spore cluster, a thread may produce, apparently only when it comes in contact with some solid substance, a compact cellular mass, which clings closely to the surface with which it is in contact. These "organs of attachment" have been observed by several students of these fungi, but their real significance is not yet understood. The compact mass is formed by the interweaving and growing together of numerous short branches of the filament on which they are formed. I have noticed, also, that an abundant development of these organs is usually associated with the formation of few conidia, and *vice versa*. But the conditions which determine the preponderance of one or the other are very uncertain; for, in case of two parallel cultures prepared in the same way and carried on under apparently identical conditions, one produced abundant conidia and few attachment organs, while in the other the former were few and the latter were very numerous.

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* Annals of Botany, Vol. II., p. 319.

The history and structure of this fungus, as above described, would lead to the expectation that there will be found among the remains of the decayed plants the small, black masses of compacted threads known as *sclerotia*, which constitute the resting states of related fungi, and from which, finally, the perfect fructification is developed under favoring conditions. Careful examination of a quantity of material has failed to show any of these bodies; but it is by no means certain that they may not be formed, at least in some cases

In its development, so far as observed, and in the details of its structure, this fungus appears to agree with the form known as *Botrytis* (*Polyactis*) *vulgaris* Fr., and is with little doubt the conidial stage of some sclerotium-producing *Peziza* (*Sclerotinia*).

From what has been said, it is evident that the thorough and careful culture and vigilant supervision of the plants are essential to the control of the disease in question. The nature of the crop forbids the trial of fungicides, and chief attention must be devoted to the healthy growth of the plants. The soil should be rich and mellow enough to insure a rapid and vigorous growth. The temperature of the houses should not be allowed to rise above the rather low point which is most favorable to the growth of lettuce, since a higher temperature diminishes the vigor of the plant and at the same time favors the development of the fungus. Too high a night temperature is probably a common cause of the rapid progress of the disease. All diseased plants and all refuse on which the fungus can live and increase should be removed at once from the greenhouse and burned. For this purpose the boiler furnace is conveniently at hand. Every bit of vegetable remains should be often and scrupulously cleaned up and destroyed. A house which has been badly infested by the disease should be thoroughly cleaned, fumigated with burning sulphur and supplied with fresh soil, before a new season's crop is started. A coat of paint or whitewash over the whole interior may also be a useful precaution. With a house thus disinfected and a crop well nourished and well cared for, one may legitimately expect practical freedom from loss by rotting.

THE POWDERY MILDEW OF THE CUCUMBER. — *Erysiphe cichoracearum* DC.*

So far as I know, the first announcement of a powdery mildew on cucumbers, in America, was made in Bulletin No. 40 of this station in August last. It has long been known in Europe and has been observed in Australia. It is not known to me to attack cucumbers cultivated in the open air, but is probably not uncommon on plants forced in the greenhouse for a winter crop. It has been sent to this department by Dr. Jabez Fisher of Fitchburg and by Prof. L. H. Bailey of Cornell University, Ithaca, N. Y.

The disease ordinarily first appears on the upper surfaces of the leaves, and sometimes on the stems, of the host-plants, in the form of small, roundish, white spots, which have the peculiarly powdery appearance which has given to this group of fungi their name. These young spots suggest the effect of scattered splashes of flour upon the plant. Microscopic study shows that the white substance consists of the threads and spores of the parasite. The surface of the host-plant is covered by a close layer of flattened cells, the epidermis, and the vegetative threads of the parasite develop close to this outer surface. They are thus truly external, instead of ramifying among the internal cells of the host, as is the case with the cucumber mildew described in the last report of this station (p. 210), and with most parasitic fungi. The only penetration of the host by this fungus occurs where its creeping vegetative threads send out, from slight lateral projections, short branches which grow downward, piercing the outer walls of the epidermal cells and swelling into club-shaped bodies within the cavities of these cells. By means of these club-shaped organs, the *haustoria*, the parasite obtains its nourishment by the absorption of the contents of the invaded cells.

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* See note, p. 219.

The superficial threads grow and branch freely, and soon begin to send up erect, vertical threads, from which, after they have reached a certain length, spores are formed by the cutting off of the tip and of successively lower portions by consecutively formed cell-walls. Each oblong segment becomes, in its turn, rounded off at the angles and somewhat enlarged at the middle, and then falls from its support, ready for germination. On a well-developed thread one may thus see a chain of spores in all stages of development. These spores may vary considerably in size in specimens from the same source; but they do not usually, if ever, differ so widely as do those from Dr. Fisher's and Professor Bailey's specimens. Between the two there is a considerable difference in form as well as in size, which may point to a specific difference in the parasites from the two sources. The remarks concerning treatment of the disease of cucumbers will apply equally to both forms, whether they represent variations of the same species or not. These spores, when fully ripe, germinate readily in water, but do not develop far. Each gives rise to a germ-tube, usually near one of the original corners of the spore; but this tube rarely reaches a length greater than twice the short diameter of the spore. On nutrient gelatine, prepared with an infusion either of prunes or of cucumber leaves, the spores will develop no farther than in water; but in a drop of water on the surface of a living cucumber leaf they send a branch of the germ-tube downward, as a haustorium, into the underlying epidermal cell, and then grow and branch freely, until a considerable mycelium, forming a spot upon the leaf, is developed. From the readiness with which the leaf and stem and all succulent parts of the plant are attacked in this way, the disease spreads rapidly, or may be artificially communicated to healthy plants.

Under favoring conditions of heat and moisture the spots increase very rapidly in size and in numbers. Those upon a leaf may become confluent and involve the whole leaf. The attacked tissues soon become yellow and then brown and dry, and the plants are rendered worthless, if not utterly killed. The parasite is not limited in its attacks to weak or poorly nourished plants; but on strong and vigorous ones it often progresses more slowly, and less completely overcomes its host than when the latter is enfeebled from some other cause. This can readily be seen in plants grown respectively on poor and rich soils, but otherwise under similar conditions.

The structure of the summer-spore stage described shows plainly that this parasite is one of the *Powdery Mildews*, and heretofore its perfect or winter form has been unknown. It has therefore been impossible to say to what particular species of the group it should be referred. It has been known as the variety *Cucurbitarum* of *Oidium erysiphoides* Fries, which embraces various undetermined summer-spore stages of this group. But during last December, on several of the leaves of cucumber plants on which the disease had been allowed for six weeks to run its course, and which were covered by the summer spores of the fungus, there appeared smoky spots perhaps half an inch in diameter. On these spots were seen the young yellow and brown spore-fruits or *perithecia* of the winter stage. These soon reached maturity, and furnished the means for specific identification of the parasite. The dark-brown ripe perithecia are provided with irregular brownish appendages around their bases, and contain several spore-sacs each. Each spore-sac contains typically and most commonly two spores; but this number is often reduced to one, and less often rises to three or even four. A careful comparison of this fungus with the described species of the genus *Erysiphe*, to which it plainly belongs, shows it to agree in all essential details of structure, perithecia, haustoria, etc., with *E. cichoracearum* DC. The appendages of the perithecia are distinctly brown in mature specimens, but less deeply colored than is usually the case with those of this species developed in the open air. This difference may, however, well be due to the different conditions under which they have developed.

It is interesting to find that this parasite, so destructive under the given conditions, is the same with one of our commonest out-of-door species in summer and fall on various *Compositæ*, asters, golden-rods and sunflowers, on *Verbenas*, on *Phlox*, and on various other host-plants, to which it does comparatively little harm.

Professor Bailey and Dr. Fisher, as well as the writer, have found that this disease may be kept in check in the greenhouse by spraying the plants as often as is necessary with a solution of sulphide of potassium (liver of sulphur) in water, an ounce of the sulphide to four gallons of water. A stronger solution injures the plants and fruits. Spraying with the ammoniacal carbonate of copper has been found even more effective. But Professor Bailey finds more effective than either exposure to sulphur vapor. This is accomplished by closing the house as tightly as possible for half an hour or an hour at a time, while it is filled by the vapor arising from a vessel of sulphur kept a little above the melting point on a small oil stove. The vessel should be porcelain lined, to protect the iron from the action of the sulphur. This vapor appears to be harmless to the host-plants while fatal to surface parasites like the powdery mildews. Great care must be taken to avoid the ignition of the sulphur, since a few minutes' exposure to the fumes of burning sulphur would be fatal to a house full of plants; but, with reasonable care in protecting the sulphur from contact with the flame and in preventing the temperature from rising too high, there should be no danger of such a catastrophe.

A house in which this disease has been troublesome should be thoroughly disinfected by burning sulphur before a similar crop is again started. The soil should be entirely removed and replaced by fresh. But that removal of the earth is not alone sufficient has been clearly shown during the past season. The house in which the study of this disease was carried on during the winter and spring of 1891 remained dry and unused during August, and early in September the soil was wholly removed. New bottoms were put in the benches, which were then filled with fresh soil. A lot of new cucumber plants were started, and in October were abundantly and spontaneously attacked by the fungus in question. There is little doubt, however, that thorough fumigation will render a house clean, so far as fungi are concerned.

VARIOUS DISEASES.

A New Potato Disease. — Late in July last, Mr. G. D. Howe of North Hadley brought to the station some specimens of potato plants whose leaves bore spots in many respects strongly resembling those produced by the rot-fungus in the early stages of that disease. He reported that the disease was spreading over an extensive field and killing the plants. A visit to the field confirmed these statements, and showed that those plants which suffered most were those which were nearest maturity, although the foliage had not yet turned yellow from natural causes. Some rows of late potatoes, which were still vigorously growing and very green, although between infected rows, were almost free from the disease. The field had been lately sprayed as a protection against rot; and another spraying of certain rows was recommended, to test the possibility of checking the spread of the disease by this means. But its spread was so rapid that the plants were killed before time could be found to make the application. The tubers were not affected in any case beyond a probable slight loss of growth, and remained perfectly marketable. A pretty thorough and careful examination of the diseased leaves showed the constant presence in the spots of mycelium, from which were developed, on the lower surface of the leaves, spore threads and spores of the form-genus *Macrosporium.* This was clearly not simply a saprophytic form following the attack of some parasite, but occurred on the very young spots with a truly internal mycelium, and had all the appearance of a true parasite.

Circumstances made it impossible to study the disease further at the time; but it seems probable that we have here a new disease of potatoes which may prove of considerable importance. Mr. Howe is confident that the same disease attacked some of his potatoes in 1890, though in a less serious form. It attacked, during August, as Mr. Howe informs me, many other fields in Hadley, where it appears to have been quite general. The report from various parts of the State of the appearance of potato "blight" without the "rot" leads one to ask if this disease may not have been much more widely spread than is known; and the especial object of this note is to call the attention of others to it, and to ask readers of this report to forward at once to the station specimens of any potato plants which are observed to be attacked in this way. A careful watch will be kept in Hadley for the disease, and arrangements will be made to give it the attention it deserves should it reappear.

Another Disease of Cucumbers. — In connection with the study of the powdery mildew of the cucumber, above described, there were received from Dr. Jabez Fisher of Fitchburg specimens of cucumber plants which were attacked by a still more serious disease than the mildew, and one apparently much more difficult to control.

This disease is characterized by a dwarfed and stunted appearance of the shoots attacked. The young fruits become deformed and distorted, and some of the leaves which reach a considerable size, perhaps because they are attacked late, turn yellow and die. Sometimes a plant will push out a new and vigorous shoot which may grow for a time, but sooner or later is pretty sure to succumb. Over the lower surface of these yellow leaves may be seen, on close examination, a delicate, white, glairy film, which recalls by its appearance a very thin dried streak of some albuminous substance. Microscopic study of this film shows it to be a web of very fine interlacing fungus threads, closely adherent to the surface of the leaf. No spore formation was ever observed on the leaves as they come from the forcing-house; but when a fresh leaf, covered with a well-developed film, was placed in a moist chamber, the threads gave rise in two or three days to numerous short, erect stalks, irregularly scattered along their sides. These stalks taper somewhat toward their tips, which are rounded or slightly knobbed, and bear the elliptical or rather kidney-shaped spores of the fungus. These spores, when placed in water, swell up by absorption of water until they become nearly or quite spherical in form, and then germinate by extending a germ-tube nearly as large as the average of the vegetative filaments of the fungus. Lack of suitable material has prevented the culture of this fungus on nutrient media or attempts to inoculate cucumber plants with the fungus, but everything points to this fungus as the cause of the trouble.

From the description given it is evident that it is one of the numerous uncertain and little-known fungus forms; and, according to our present system of classification, it must be placed in or very near the form-genus *Acremonium.* Should the disease reappear the comming winter, special attention will be given to it and especially to the determination of its etiological relation to the disease in question.

The present incomplete note is here inserted as a preliminary record of a new disease of cucumbers and of what has been observed in connection with it, with the primary object of calling the attention of other pathologists and of growers of cucumbers under glass to it. It is especially requested that any person who observes this or any similar disease will promptly notify the writer of its presence, and send specimens and all possible details concerning its appearance and spread. Dr. Fisher states that this disease reduces the yield of badly attacked plants to ten per cent. of the normal. It seems difficult to combat, as it steadily increased in his houses in spite of applications of all the most efficient fungicides.

Rye Fungi. — The winter rye on the station plots was attacked severely by three fungi. In June many of the leaves showed the swelling and distorting effect of the leaf smut (*Urocystis occulta* Wallr.), further details concerning which will be found in another part of this report. It has not as bad a reputation and is not as well known as the grain smuts, but it undoubtedly does much harm in weakening the plant and so in reducing the production of both grain and straw.

At the same time with the smut there appeared in extensive orange patches on the leaves the summer spores of one of the grain rusts (*Puccinia rubigo-vera* (DC.) Wint.), so abundantly that they arose in clouds when the plants were shaken. Later the leaves of summer wheat on adjoining plots were very badly affected. In July this stage of the fungus had largely disappeared, and the leaves of the rye were blackened by the winter-spore pustules of the same fungus.

The life-histories of this and the related species of rusts are not yet fully understood, and our only protection at present is in destroying as completely as possible the stubble and all refuse which can harbor their spores in the field. Observations by the writer, made as his share in certain co-operative studies of the grain rusts, seem to indicate that this rust does not survive the winter in its host-plant, but depends upon fresh infection in the spring. On our plots the summer-spore pustules on rye seedlings survived the early frosts, and seemed vigorous until the heavy frosts and first snowfalls. The plots were then covered continuously by snow until spring. When they were again exposed, the discolored spots where the spore-pustules had been could be readily observed, and examination showed a mycelium to be present in the spot. But it was apparently dead, for repeated examination of the plots failed to detect new spores breaking out from any of these old spots. The fungus was not observed after growth was resumed until early in June, when a few warm and moist days increased the amount present from a few scattered spots to a general epidemic.

The virulence of this attack of rust caused a marked weakening of the plants, as was shown by the yellow color of their leaves and by the abundant presence upon the leaves — most abundant on the weakest ones — of the saprophytic fungus form known as *Cladosporium herbarum* (Pers.) Lk. The sooty patches of this with the orange masses of the rust pretty completely covered the leaves and left little or no normal tissue.

It is noteworthy, as illustrating the general principle repeatedly laid down in these reports, that on those plots which had been supplied with abundant and readily available nitrogen the effects of the fungi were much less serious than where the supply of nitrogen was deficient in quantity or in availability. The difference was especially striking in respect to the discoloration of the leaves, which was less in proportion to the amount of rust present on the well-fed plants.

The Club Root of Cabbages (*Plasmodiophora Brassicæ* Wor.) appeared for the first time on a part of the station grounds during the past season. The first specimens were obtained when the largest leaves were about six inches long. At this time, in the worst specimens the main root and its lateral branches were attacked and swollen into a nearly solid mass of the size of a hen's egg. The parts of the affected plants above ground did not at this time differ essentially in appearance from their neighbors, and were recognizable chiefly by the fact that in warm, sunny weather the foliage became wilted from the lack of sufficient root hairs on their swollen roots to absorb the necessary water to supply the demands of active transpiration. These plants failed entirely to form "heads," and were therefore rendered worthless by the disease. Microscopic examination of the diseased roots at different times showed the various stages in the development ot the parasite as they have been described and figured by Woronin.

Early in the season, just after the spring ploughing, soil was taken from a field which had been planted to cabbages the previous season and had produced a considerable number of "stump-footed" ones. This soil was placed in a flower-pot in the greenhouse and sown with cabbage seed. In due time some of the seedlings were attacked by the club root fungus in characteristic fashion, this showing the survival in the soil and their probable pretty general distribution through it, after ploughing, since a single flower-pot full taken at random contained at least several of them.

It is a matter of general observation among market gardeners and others that on some soils, especially heavy and moist ones, it is not profitable to plant cabbages two years in succession, on account of the prevalence of club root the second year. But it has also been remarked that two crops equally free from disease may be raised in one season. This fact is interesting as a practical demonstration of the fact that the spores of the club-root fungus are *resting spores*, and require a season of quiescence before they are able to germinate and reproduce the disease.

After a year or two of other than cruciferous crops (cabbages, turnips, radishes, etc.), the danger from the disease is past, and the latter may again be planted for a year.

The Blight of Celery, which forms spots on the leaves, is due to a parasitic fungus form which bears summer spores, known as *Cercospora Apii* Fres. That this represents merely an imperfect form of some fungus whose perfect form probably lives saprophytically, cannot be doubted; but no other form has thus far been connected with it. I have observed on celery, from the farms of Messrs. W. D. Philbrick of Newton Centre and A. H. Smith of West Springfield, that, after the brown blight spots have spread over the leaves and they have collapsed upon the ground, there appear upon them the tiny black pustules of one of the pycnidial forms known as *Septoria*. From the analogy of other cases and from the evidence of a series of specimens in different stages of the disease kindly sent by Mr. Smith, it is easy to believe that the *Septoria* form represents another stage in the history of the same fungus to which the Cercospora form belongs, although I have not been able to make cultures. One would, however, expect little additional evidence except from cultures of the perfect spore-form, which we do not yet know.

Since there have already been described several so-called species of *Septoria* on various umbelliferous plants which differ in no essential particulars from this form and from each other, it would be worse than superfluous to add here another to the already large list of names which have been given to what must eventually be shown to be a single form. And especially so since this form is undoubtedly merely an imperfect stage in the life cycle of some fungus for which, when its whole course of development is known, only a single name can stand; while the host of names inconsiderately given to its various imperfect forms will constitute only a cumbrous and useless synonymy. So far as it has been possible to examine material and descriptions, it appears that this form on celery is separated by no distinct features from the following previously described ones on *Umbelliferae*: *S. Sii* Rob. & Desm., *S. Cryptotaeniae* E. & Rau, *S. Saniculae* E. & E., *S. Dearnessii* E. & E. and *S. Petroselini* Desm.

Our form may be described as follows: Pycnidia appearing on the brown leaves after the coalescence of *Cercospora* spots, amphigenous, black, scattered, 100 to 160 mmm. in diameter; flattened when of the larger, globular when of the smaller, diameter; pycnospores somewhat curved, slightly tapering to both ends, usually 3-septate, rarely 2- or 4-septate, 24.-34. x 1.7-2. mmm.

It remains much to be desired that the perfect form of this fungus should be discovered. It will probably be found eventually on blighted celery leaves which have lain on the ground through the winter, or on rubbish near by, in spring.

Note. — Since the above was written Mr. F. D. Chester, of the Delaware Experiment Station, has described * what is doubtless this form as occurring on celery in that State, and thinks it may be that known in Europe as *Septoria Petroselini* Desm., var. *Apii* Briosi.

Clover Fungi. — Two fungi annually cause much damage to the clover on the station meadows and elsewhere in Amherst and in other parts of the State. One of these is the rust fungus (*Uromyces Trifolii* (Hedw.) Lév.), which is most harmful in its summer and winter spore stages, which are developed almost simultaneously in June and July. They appear in the form of pustules of different shades of brown, which burst through either surface of the leaf, and consist of the closely packed spores of the fungus.

The other fungus is the black mould (*Polythrincium Trifolii* Kze.), which appears in thickly scattered black spots over the under surface of the leaves. This form is often followed by the development of black crusts on the affected leaves, which have been named *Phyllachora Trifolii* Pers., and are supposed to represent the perfect form of the fungus; but the winter spores which should develop in them have never been described.

Both of these fungi reduce the fodder value of the clover to a minimum, and cause considerable reduction in the size of the leaves and in the general vigor of the plant, and are therefore real pests and sources of real loss.

A Fish-hatchery Fungus. — Early last spring I received from the Northampton fish-hatching establishment, through

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* Bulletin Torrey Bot. Club, December, 1891, p. 373.

Dr. J. B. Paige of the Agricultural College, specimens of trout eggs attacked by fungous filaments. These filaments were not in the fruiting stage; but when dead flies were thrown into the water containing the eggs, they were promptly attacked by similar filaments, which soon developed both non-sexual and sexual reproductive organs, from which the fungus was readily determined as *Achlya racemosa* Hild. I am informed by H. E. Maynard, Esq., of Northampton, that the eggs suffer most when first placed in the hatching trays. It is generally believed that only dead eggs are attacked; yet the fact, which is commonly observed, that, if the eggs are not removed from the trays as fast as they die, the fungus will extend to all the eggs, shows plainly that this cannot be the case. If it were able to attack only dead eggs, the fungus could not be a source of harm, and its presence in the trays could not endanger living eggs. It does not, as far as I can learn, attack the young fry after hatching.

The only effective means of preventing the spread of this affection lies in the frequent removal of all dead eggs from the hatching trays.

Rust of Poplars. — The European black poplar (*Populus nigra* L.) has been considerably planted on the grounds of the Agricultural College and elsewhere in Amherst.

The trees are attacked annually in September by the poplar rust (*Melampsora populina* (Jacq.) Lév.), and during the past two seasons the attacks have been very severe. The disease first shows itself in the yellowing of the lower leaves, due partly to the fading of their natural color in consequence of the presence of the parasite, and partly to the development on their lower sides of the abundant deep-yellow summer-spore masses of the rust. There now follows a definite upward progress of the disease, and when the middle part of the tree is reached, the lower leaves are falling in great numbers and the lower limbs soon become stripped of foliage. This results in two to three weeks after the first appearance of the disease. By the time they fall the leaves have become brown in color, from the further degeneration of their pigment and the replacement of the summer spores by the brown crusts of compacted winter spores. The leaves then lie upon the ground until spring, when the winter spores germinate and infect the new season's foliage.

It is evident that much of the harm done by this rust in rendering the trees unsightly and in causing premature defoliation can be avoided by thoroughly cleaning up and burning all the fallen leaves before snow falls, while the winter spores are still incapable of germination.

Anthracnose of Chestnut. — Since the cultivation of the chestnut is beginning to receive attention in some quarters, and bids fair to be attended with considerable success, it may be worth while to mention a fungus which, from its prevalence on wild chestnuts about Amherst, seems likely to prove troublesome to the cultivated plant. This fungus, which must be known as *Marsonia ochroleuca* (B. & C.), causes an anthracnose of the leaves in the form of small, thin, bleached spots, on which the spore pustules are formed. These spots are sometimes so abundantly developed as to cause the leaves to shrivel and die; and the fungus may be expected to do much greater harm to trees growing under the artificial conditions of cultivation.

The Black Knot of the Plum. — The study of this disease has been continued during the past year, both theoretically and practically. Some trees in an advanced stage of the disease have been put in charge of this department for treatment, and progress has been made in both lines of study. But the results obtained have not been so complete as was hoped for, partly on account of the limited material at my disposal and partly because a large amount of time was required for other studies reported here. Therefore it seems best to reserve the results obtained until they can be combined with those hoped for during the coming year, in a more complete and hence more satisfactory account.

Diseases of Tobacco. — This department has communicated with some leading tobacco growers in the Connecticut valley during the past fall, with a view to the investigation of the various diseases or affections to which tobacco is subject in the curing shed. These are known chiefly under three names, white vein, pole sweat and pole rot. How far these names represent affections due to distinct causes it is impossible to say, since they have apparently caused no loss in this State during the past season, and it has not been possible to obtain material for study. The purpose of the present note is to call the attention of tobacco growers to the fact that the department is desirous of studying the diseases named, and to ask them to notify the writer of the existence of any such in their barns next season. It seems very probable that much can be done towards a better understanding of the nature and means of prevention of these sources of loss. The writer desires here to thank those growers who have so promptly replied to his inquiries, and hopes to be as promptly informed of the existence of opportunities for the study of these diseases.

Preventive Treatment.

A somewhat extended account of the principles underlying the preventive treatment of fungous diseases of plants, with detailed directions for the preparation and application of the most efficient fungicides, was issued as Bulletin 39 of this station, in April last. That interest in this subject is being awakened was shown by the demand for the bulletin and for further information; but it is impossible to say to what extent its recommendations were acted upon, as very few persons have communicated to the department any report of such treatment or its results. The bulletin named can still be furnished, on request; but the more important points of the discussion are given below.

Since a plant which is once fairly attacked by a fungus is lost, treatment must be directed toward preventing the development of fungi upon the plants to be saved. Protective measures may be of two sorts; those which remove possible sources of infection from the plants, and those which fortify the plants against infection. The latter of these objects is accomplished by the use of *fungicides;* the former may be largely accomplished by *hygienic treatment.*

There are definite laws of health for plants as well as for animals, and in one case, as in the other, neglect of those laws invites disease. In the first place, plants which are expected to grow and thrive must be furnished with an abundance of the materials necessary to growth. Weak, poorly nourished plants suffer the attacks of parasites of all sorts, and have no power to resist them. Secondly, where a crop has suffered from a fungous disease in one season and a good crop of the same kind is desired in the following season, every tangible trace of the disease must be removed. For example, if a vineyard has suffered from *mildew* or *black rot*, all diseased leaves and berries should be collected at the end of the season with scrupulous care and wholly burned; and the same advice applies to a large list of cases. Thus incalculable numbers of the spores of the fungi of the respective diseases will be prevented from infesting the next season's crop. In some cases where the spores remain in the soil, as in the *stump foot* of cabbages or the *smut* of onions, the attacks of the disease can only be avoided by rotation with crops upon which the fungus in question cannot live. Thirdly, wild plants, which, being nearly related to a given cultivated one, may be subject to the same disease, or which bear a complementary spore form of a pleomorphic fungus, should be carefully excluded from the neighborhood of cultivated ones. Thus, wild cherries or plums, which are equally subject to the *black knot*, should be kept away from plum orchards; and spinach fields should be kept free of pig-weed, since both plants are attacked by the same *mildew;* and again, since red cedars bear one spore-form of a fungus whose other form is the *rust* of apple leaves, it is plain that they should not be allowed to grow near an apple orchard.

The importance of these preventives is often underrated by persons who understand and use successfully other forms of treatment. It is evident, however, that, in removing as completely as is possible the conditions which favor the abundance and increase of a fungus in the vicinity of its host plant, half the battle is won. When this has been done, we may protect the plants by the external application of *fungicides*.

These preparations, when properly prepared and when applied at the right times and in the right way, have been abundantly proved to be of the greatest value, and often to determine the difference between a full crop from plants on which they are used and practically no crop where they are not applied.

But the fact cannot be too strongly emphasized that everything depends upon how they are prepared, and upon *how* and *when* they are applied. The following pages attempt to give somewhat full instruction *how* to prepare and apply the most valuable fungicides, and such general hints *when* to apply them, as will be of service. The proper times for their application vary so much with special conditions, however, that instructions on this point must form an important part of the special directions for any particular case.

Preparation. — The protective quality of most of the best fungicides lies in the fact that they contain a certain proportion of copper; and, of the four recommended as applicable to most cases of fungous diseases, three contain it as the essential constituent.

The Bordeaux Mixture requires six pounds sulphate of copper, four pounds quicklime (fresh) and twenty-two gallons water. The sulphate of copper, known to the trade also as blue vitriol or blue-stone, is dissolved in two gallons of water. The solution will be hastened if the water be heated and the sulphate pulverized. After the solution is complete, fourteen gallons of water are added to it. The quicklime is slaked in six gallons of water, and stirred thoroughly until it forms a smooth, even mixture. After standing for a short time it is again stirred and added gradually to the sulphate solution, which is thoroughly stirred meanwhile. The mixture is then ready for use, though some experimenters recommend further dilution to twenty-five or thirty gallons, for certain uses. It should not be prepared until needed, and should be used fresh, as it deteriorates with keeping. Since the lime remains merely in suspension and is not dissolved, the mixture should be strained through fine gauze before entering the tank of the spraying machine, so that all of the larger particles which might clog the sprayer may be removed.

Ammoniacal carbonate of copper, in its improved form, is prepared from three ounces carbonate of copper, one pound carbonate of ammonia and fifty gallons water. Mix the carbonate of copper with the carbonate of ammonia, pulverized, and dissolve the mixture in two quarts of hot water. When they are wholly dissolved, add the solution to enough water to make the whole quantity fifty gallons. This preparation has been found to be better and cheaper than that made according to the original formula, which is as follows: Dissolve three ounces carbonate of copper in one quart aqua ammonia (22° B.),* and add the solution to twenty-five gallons of water.

Dr. Thaxter, formerly of the Connecticut Experiment Station, has suggested that a very large saving may be made by preparing the carbonate of copper by the following method, instead of buying it, as its market price is much greater than that of the materials necessary for its preparation: Take two pounds of sulphate of copper and dissolve it in a large quantity of hot water; in another barrel or tub dissolve two and one-half pounds of carbonate of soda (sal-soda) in hot water. When both are dissolved and *cooled*, pour the soda solution into the copper solution, stirring rapidly. There will result a blue-green precipitate of carbonate of copper, which must be allowed to settle to the bottom of the vessel. Now draw off the clear liquid above the sediment, fill the vessel with fresh water and stir up the contents thoroughly. After the copper carbonate has once more settled to the bottom, again draw off the clear fluid above. The carbonate may now be removed from the vessel and dried, when it is ready for use. From the amount of blue-stone and sal-soda given above will be produced one pound of copper carbonate, and the amount of each necessary to produce any given amount of copper carbonate is easily calculated.

Sulphate of copper is used in solutions of varying strength for certain special cases.

Sulphide of potassium, known also as sulphuret of potassium or liver of sulphur, has been found useful in the treatment of diseases caused by those fungi known as powdery mildews, especially on plants grown under glass. It is ordinarily used in the proportion of half an ounce of the sulphide to one gallon of water.

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* Dealers usually handle ammonia water of a strength of 24° B. (=22.5% ammonia) or of 26° B. (=26.5% ammonia). To reduce these to the required strength, 22° B. (=19% ammonia), add *four* parts of water to *ten* of aqua ammonia of 26°, or *two* parts of water to *ten* parts of 24° aqua ammonia.

Materials. — For the convenience of persons who may wish to purchase the necessary materials for the preparation of fungicides, the writer has communicated with several reliable houses in some of the larger cities of the State, and has received from those named below favorable replies as to their readiness to fill orders promptly, and as to prices. He can, therefore, recommend these firms to persons wishing fungicide supplies, without in any respect implying that there are not many others equally reliable : —

Weeks and Potter Company, 360 Washington Street, Boston.
Messrs. E. & F. King, Boston.
Talbot Dyewood and Chemical Company 24 and 26 Middle Street, Lowell.
Jerome Marble & Co., Worcester.
Messrs. H. & J. Brewer, 463 Main Street, Springfield.

Concerning the cost of the various materials named above no very exact figures can be given, since prices vary with the state of the market and according to the quantity ordered. Prices per pound are considerably higher for small quantities than for larger ones, and the substances cost *much* less in original packages than in smaller lots. A large saving can be affected if several persons will combine in ordering what they need, both in the cost per pound of the chemicals and in cost of transportation. The following quotations may be given as the approximate prices of the various substances in *small* lots, at retail, and discounts from these prices will increase with the amount of the order : —

	Cents per Pound.
Copper sulphate,	8
Copper carbonate,	60
Ammonium carbonate,	15
Sodium carbonate,	3
Aqua ammonia (24°),	10
Potassium sulphide,	25

Application. — In the case of diseases caused by fungi which spread from plant to plant during the growing season, the necessary protection is afforded by applying the fungicides in the form of a very fine spray to the surface of the plants until they are thoroughly wetted. This, drying, leaves a thin film over the plants, which is fatal to fungus spores that may fall upon it. Suitable spraying apparatus is of the first importance to success in the use of fungicides, especially a nozzle which shall allow the escape of only the finest spray. The ordinary spraying nozzles used with hose or with small hand pumps are utterly unsuited to this purpose. The best form is, perhaps, that known as the Vermorel nozzle, which is furnished with many pieces of apparatus, or may be purchased separately. This nozzle gives a very fine and steady spray, which may be instantly cut off, and is the best suited for the Bordeaux mixture, since it has an attachment for promptly freeing it of clogging particles. Another excellent nozzle for the other fungicides described, which are clear solutions, is the Nixon nozzle.

For supplying the necessary pressure to drive the liquid through the nozzle in the form of spray, some form of force pump is necessary. The form chosen must depend on the amount of work to be done and the character of the plants to be treated. We may distinguish three general types. The *knapsack* type is suitable for almost any small job, the importance of which does not justify the purchase of a more expensive apparatus, and is especially adapted to use upon low-growing plants cultivated in hills or rows. These machines have a tank holding a few gallons with a pump worked by a lever with one hand, while the other hand directs the nozzle, the apparatus being strapped upon the back of the operator. The *hand-cart* type of pump consists of a large reservoir, representing the body of the cart, connected with a force pump, and the whole mounted on two or three wheels with a handle for pulling or pushing. The *horse-cart* type of machine includes a larger reservoir and more powerful pump, capable of throwing several streams, mounted on wheels, to be drawn through the field or orchard by horse-power.

For information concerning the details and prices of the numerous spraying machines on the market, the reader is referred to the catalogues, which will be sent on application, of the Nixon Nozzle and Machine Company, Dayton, O.; The Goulds Manufacturing Company, Seneca Falls, N. Y.; Albinson & Co., 2026 Fourteenth Street, Washington, D. C.;

Adam Weaber and Son, Vineland, N. J.; Rumsey & Co., Seneca Falls, N. Y.; Field Force Pump Company, Lockport, N. Y., or W. & B. Douglas, Middletown, Conn.

When to Apply. — As has been said, this question is of the first importance in dealing with any disease, but the answer varies with the case in hand. In general, however, let it be remembered that all treatment is preventive, that plants once attacked are lost, and that spraying must therefore be prompt and early. In the case of a disease of an herbaceous crop like potatoes, the first spraying should be given *at once* on the appearance of the disease in any part of the field or a neighboring field. The same applies to diseases of woody plants which have previously been free from disease; but where grapes or apples, for instance, were attacked last year, treatment should begin with the beginning of growth, and should proceed on the assumption that the disease will reappear if not prevented. In any case, after spraying is begun it must be repeated until danger is past, — a very variable period, — at intervals which may average ten days or two weeks, but will vary according to circumstances, depending especially on the amount of rainfall, which washes the copper salts from the plants and renders a new application necessary. It is always best to leave an occasional plant or row of plants untreated among the treated ones to furnish a basis for judgment as to the efficacy of the treatment.

Quantities Needed. — It is very difficult to give any statement of the amount of a fungicide required to properly spray any of the various plants on which it may be used.

The size and leaf surface of plants of the same kind vary so much with their age, the conditions of cultivation, and other controlling factors, that it is hardly possible to say what is an average plant of any sort. Besides this, very few experimenters have published statements as to the quantities used in their work. Yet one of the first questions asked by a beginner is, "How much do I need?"

With these facts understood, the following figures may be given as approximate statements of the amount of a preparation required for properly spraying the crops named, when a suitable and economical nozzle is used. For another plant the amount can be roughly estimated by a comparison of its leaf surface with that of one of these ; For apple-trees, one and one-half to two gallons to a good-sized tree ; for grapevines, one gallon to six or eight well-grown vines ; for potatoes, one hundred to one hundred and twenty-five gallons per acre.

A Caution. — Certain observations of the writer and certain well-known incidents in the fruit trade during the past season show that the use of fungicides, like every other good thing, may be carried to extremes by inexperienced or incautious beginners or by over-zealous friends. It is undeniably true that the free use of copper preparations has been recommended far too promiscuously and too inconsiderately in certain quarters for every fungous ill which vegetable "flesh is heir to." It is, or ought to be, self-evident that, on plants whose foliage is to be eaten, like lettuce, these preparations should *never* be used. On plants like the potato, which are cultivated for subterranean parts, their use is perfectly safe ; while to fruit-trees and vines the Bordeaux mixture, at least, should not be applied after the fruit has begun to ripen. If, from its nature or through favoring conditions, a disease makes its appearance after the fruit has begun to color, much can be done to prevent its spread by removal of diseased parts and rigid hygienic precautions. But, from the point of view of profit and loss alone, it is not worth while to save a crop to be seized by some vigilant board of health, which can afford to err only on the side of safety. Our present methods of treatment, while sufficient and unobjectionable for certain cases, must be regarded as only temporary and for the present better than nothing, in many other cases. For many diseases our only remedy yet known is quite as bad as the disease, and it is not to be expected that public sentiment will long tolerate the use of poisonous insecticides and fungicides where such use involves any possible danger.

Some Experiences. — The responses to the offers of assistance contained in this bulletin, while not so numerous as they should have been, were yet encouraging. They show that our most progressive farmers and gardeners are beginning to appreciate what this department is glad to do for them. It is not known to what extent many of those who wrote for further information and advice practically applied it; but reports have been received from some which speak for themselves. Such is that of Mr. J. N. Pardee of South Billerica, who sprayed his apple trees only twice with Bordeaux mixture, containing Paris green, once on the 1st and once on the 13th of June. In each case the spraying was followed, the next day, by a heavy shower. Thinking the rains must have washed off the combined fungicide and insecticide, and that it was too late for further treatment to be effective, he did nothing more. Concerning results, he writes: "The fruit from the sprayed trees and parts of trees did not drop off as freely as from the unsprayed trees, and is uniformly fair, with clean, smooth skin, and two-thirds grade as choice No. 1, while the other third brings a good price as seconds. It is fair, but wormy. The fruit from the unsprayed trees and parts of trees is almost uniformly covered with black spots. The sound apples will not grade as first-class No. 1, while the wormy apples go for cider, and less than one-third of the fruit is sound. As all other conditions, soil, care, etc., have remained the same, I do not know what to attribute the difference to, except to the spraying. The cost of the material for the two sprayings was about fifteen cents per tree, and the time taken to spray thirty trees twice was about three hours for two men and a horse." It is evident that the secret of the efficacy of this slight treatment is to be found in the fact that it was applied at just the right time in the development of the fruit, and that the preparation was not washed off by the rains which immediately followed its application.

Mr. N. E. Baker of Lawrence has sprayed his carnations with the improved form of ammoniacal carbonate of copper both before and since putting them in the house, as a protection against the leaf-spot fungus (*Septoria Dianthi* Desm.), and reports that the new growth is vigorous and healthy.

These examples serve to show what may fairly be expected from the proper use of fungicides well applied, and it is hoped that they may encourage many others to try them next season. As a further stimulus in this direction it is proposed to give annually in these reports special detailed instructions for the treatment of some group of diseases caused by fungi whose life histories are so similar that the same directions will apply to all. The symptoms of each disease and its effect on the diseased plants will be described, and enough of the life history of the parasite will be given to make clear the reasons for the treatment prescribed.

The group chosen for the present report is one of the best known as to the life history of its members, some of which are among the most easily avoided of all the fungi. It will, therefore, serve as an excellent introduction to the subject. Furthermore, the simplicity of the preventive treatment for some of these diseases will serve to tempt the reader to undertake it, and its striking efficacy will encourage the beginner to try the more laborious treatment for other troubles. The diseases in question are those known as SMUTS. (See Plate I.)

Of the large number of smut fungi which attack plants of all sorts, the number of those which are sources of loss to Massachusetts farmers to such an extent as to deserve mention here is five or six. They are those which cause the diseases known as the loose smuts of oats, barley and corn, and the leaf smuts of rye and of onions.

The loose smuts are peculiarly harmful, because the black smut-masses are formed only in the seeds or grains, the very part for which the plants are cultivated. These smuts of oats, barley and wheat have been regarded until lately as belonging to a single species known as *Ustilago segetum* (Bull.) Ditm.; but those who have studied them most carefully now consider that they include four species, distinguished by differences in spore germination, and by their restriction to particular hosts and their inability to attack others. They are called respectively *Ustilago Avenae* (Pers.), on oats, *U. Hordei* (Pers.) and *U. nuda*, (Jensen) K. & Sw., on barley, and *U. Tritici* (Pers.), on wheat. As the *oat smut* has been studied most and is best known, and is also perhaps the form which causes most loss in Massachusetts, it may be described here as a general type (Fig. 1.)

This fungus can penetrate only the very young tissues of its host plant, and is harmless to tissues whose outer cell walls have begun to harden. To be effective, the fungus-threads must reach the growing tip of the host and develop with it; thus giving no sign of their presence until the plant is well grown and the heads are formed. But the growing point can only be reached when the very young seedling is attacked; therefore all attacks at a late period in the life of the host are soon overcome and outgrown. Now the tuft of hairs or "beard" and the "hulls" of the grain afford very convenient lodging places for smut spores, which are thus sown with the seed, germinate with it, and are ready to attack the young seedling at just the time when their attack is most effectual. Besides, these spores germinate most freely in fresh manure, and produce multitudes of germs which can attack the host plant under favorable circumstances. As it is probable that the spores can pass through the animal body unharmed, the manure from animals which have eaten smutted grain must be a very important source of infection. But it has been shown that the reproductive power of these germs becomes exhausted in the course of a year in manure; therefore old and well rotted manure, while otherwise better for the crop, is also harmless as a carrier of disease.

Professor Kellerman, formerly of the Kansas Agricultural College, has estimated that in Kansas the average annual loss of oats from this disease is equal to six or seven per cent. of the crop, and there is no reason to suppose that this estimate is too high for our own State. On the basis of the statistics of the United States Department of Agriculture this would give an annual loss in Massachusetts of $20,000 from this single smut. Nearly the whole of this amount might very easily be saved, if our farmers would apply the very simple treatment which will certainly limit the disease to an occasional stalk. This consists in soaking the seed for fifteen minutes in hot water, kept at a temperature of 132° F., or for twenty-four hours in a solution of one pound of potassium sulphide (liver of sulphur) in twenty-four gallons of water. Neither of these treatments injures the seed, but, on the contrary, distinctly increases the crop.

Of the *barley smuts* (Fig. 2) one seems to yield readily to the same treatment, while the other seems not to be prevented by it; but, as both forms commonly occur on the same field, at least a considerable decrease in the loss from smut may be expected to follow the treatment of barley with hot water before planting.

Wheat is not a crop of sufficient importance in Massachusetts to make any extended mention necessary here. It is subject not only to the loose smut mentioned above (Fig. 3), but also to the so-called hard or stinking smut or "Bunt" (*Tilletia* sp., Fig. 6). The latter of these is completely controlled by the hot-water treatment, but the former seems not to be affected by it.

A few practical directions for applying the hot-water treatment may be useful here. The seed should first be thoroughly wetted in cold water, and all imperfect seeds and other bodies which float on the top skimmed off. Two kettles of water should be provided, that in one at a temperature of 110° to 120°, and that in the other at the temperature required for the treatment, 132°. The latter should be kept as nearly as possible at the same temperature throughout the treatment, by the addition of hot or cold water whenever the thermometer shows it to be necessary. The seed is taken in lots of perhaps half a bushel at a time in a basket of wire gauze or a bag of very loosely woven material, and plunged first into the cooler water, lifted out and plunged again until it is thoroughly wetted and warmed. This is important, that the seed may not cool the hotter water too much. Now the basket or bag is transferred to the latter and allowed to remain fifteen minutes, during which it is occasionably lifted and lowered and turned about, to ensure the complete wetting of every grain. When the seed is removed it is quickly cooled with cold water and spread out until it is dry enough to be sown.

In the case of the *corn smut* it is not merely the young grains which are attacked, but the pustules may be found upon any part of the plant; and an infection of any part sufficiently young to be penetrated by the fungus gives rise in a few weeks to smut pustules. Thus the plant is not beyond liability to infection until all its tissues are hardened; that is, until the "tassel" appears.

The only treatment for this trouble which can be confidently recommended is the prompt removal and destruction of all smutted parts as soon as they appear. It should hardly be necessary to call attention to the fact that to throw them into the compost heap is not to destroy them, but is often the surest means of perpetuating and disseminating the disease.

Fig. 5 shows a portion of a "tassel" of corn attacked by smut.

The leaf-smut of rye (Fig. 4) forms its black masses on the leaves and stems of rye, which are often considerably distorted by it. It does not, therefore, cause a direct loss of grain, but indirectly reduces the crop by weakening the plants which are attacked.

The same is true of the *onion smut*, which forms its pustules on both leaves and bulbs, and commonly kills its host. If the attack is not too severe, however, the plant may recover, though greatly weakened and never producing a strong bulb. It appears that only the young seedlings are susceptible to attack. This smut is propagated by means of the soil, and its spores may retain their vitality in the earth for several years. Treatment must consist in sowing with the onion seed some fungicidal substance which shall prevent the development of the smut spores in its vicinity, and the consequent infection of the seeding onions. The substance which gives most promise in this line at present is flowers of sulphur, although its protective effect is not all that can be desired. When a field becomes badly infected it should be used for some other crop, and the onion crop transferred to fresh ground for several years, at least.

For the assistance of any who may not feel certain as to the identify of the diseases here discussed, a plate is appended showing the characteristic appearance of the various smuts here mentioned, except that of onions. This plate was made from a photograph taken directly from specimens of diseased plants, and shows the effects of the various fungi on their respective host plants very clearly. With its help one should be able to identify the diseases represented without doubt.

EXPLANATION OF PLATE I.

Appearance of Some Smut Diseases.

(All figures of natural size.)

Fig. 1. Loose Smut of Oats, *Ustilago Avenæ* (Pers.) Jens.

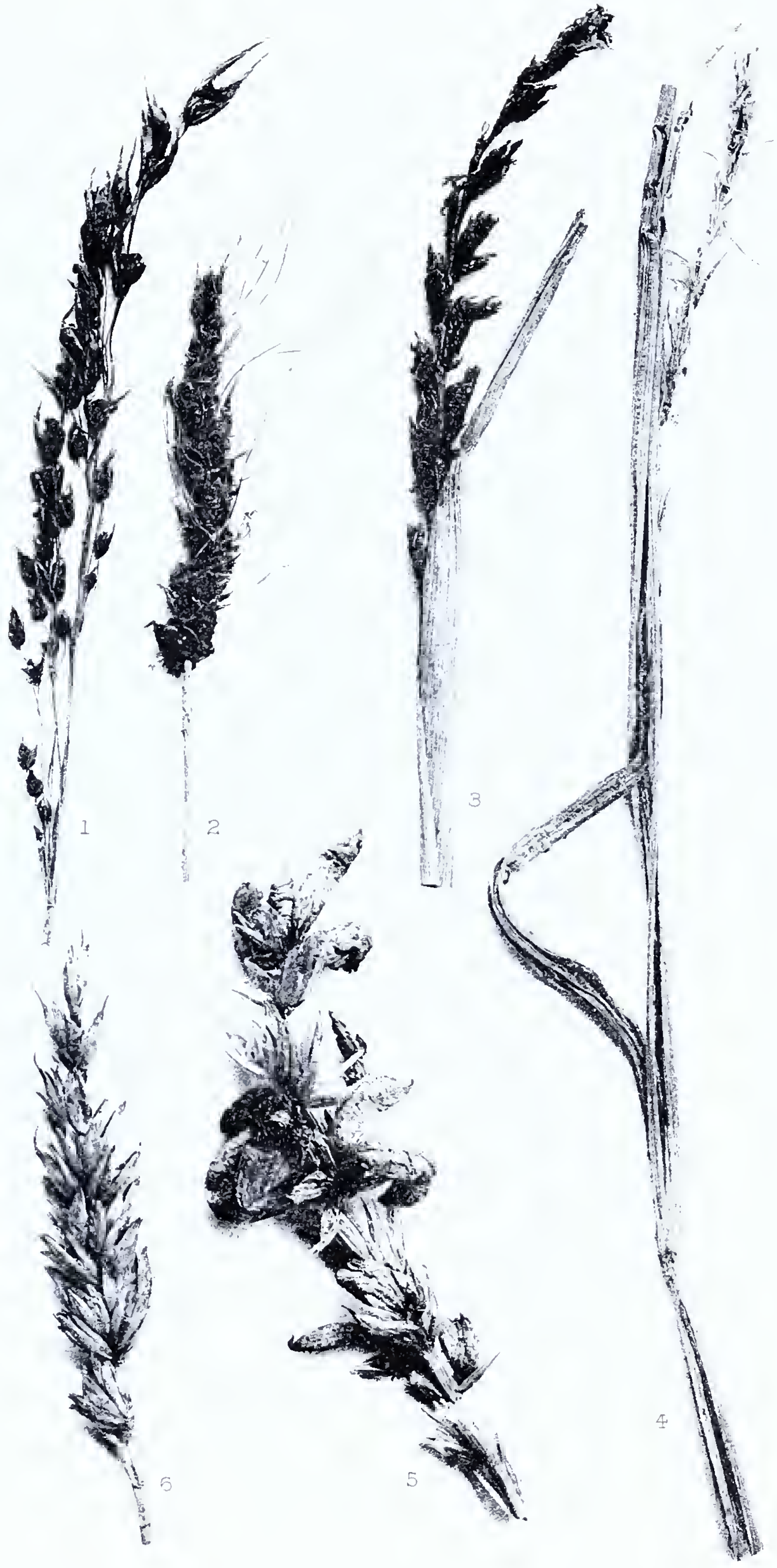
Fig. 2. Loose Smut of Barley, naked form, *U. nuda* (Jens.) Kell. & Sw.

Fig. 3. Loose Smut of Wheat, *U. Tritici* (Pers.) Jens.

Fig. 4. Leaf Smut of Rye, *Urocystis occulta* (Wallr.) Rabh.

Fig. 5. Smut of Corn in the staminate flowers or "tassel," *Ustilago maydis* (DC.) Cda.

Fig. 6. Stinking Smut or "Bunt" of Wheat, *Tilletia fœtens* (B. & C.) Trel.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PART III.

SPECIAL WORK IN THE CHEMICAL LABORATORY.

I. Communication on Commercial Fertilizers:—

1. General Introduction.
2. Laws for the Regulation of Trade in Commercial Fertilizers.
3. List of Licensed Manufacturers for May 1, 1890, to May 1, 1891.
4. Analyses of Licensed Fertilizers.
5. Analyses of Commercial Fertilizers and Manurial Substances sent on for Examination.
6. Miscellaneous Analyses.

II. Water Analyses.

III. Compilation of Analyses made at Amherst, Mass., of Agricultural Chemicals and Refuse Materials used for Fertilizing Purposes.

IV. Compilation of Analyses made at Amherst, Mass., of Fodder Articles, Fruits, Sugar-producing Plants, Dairy Products, etc.

I. Communication on Commercial Fertilizers.

1. General introduction.
2. State laws for the regulation of the trade in commercial fertilizers.
3. List of licensed manufacturers and dealers for May 1, 1890, to May 1, 1891.
4. Analyses of licensed fertilizers.
5. Analyses of commercial fertilizers and manurial substances sent on for examination.
6. Miscellaneous analyses.

1. *General Introduction.*

The sale of commercial manurial substances, compound and simple, has been quite active in our State. Forty-eight manufacturers and dealers have applied and received a license for the sale of their various brands in our State. Twenty-six of them are residents of other States.

One hundred and ninety-two samples of licensed articles have been collected in all parts of the State by a duly authorized agent of the station. One hundred and fifty-eight of them have been carefully analyzed at the chemical laboratory of the station with the following results: six samples contained all three essential constituents above the highest guarantee; eighteen samples contained two of the essential constituents above the highest guarantee; forty-two samples contained one of the essential elements above the highest guarantee; sixty-one samples contained all three essential elements at the lowest guarantee; fifty samples contained two elements at the lowest guarantee; thirteen samples contained one element at the lowest guarantee; no samples contained all three essential elements below the stated lowest guarantee; nine samples contained two elements below the stated lowest guarantee; forty-two samples contained one element below the lowest stated guarantee.

The deficiency in one or two essential constituents was in the majority of instances compensated for by an excess in the others. The variations in the market price of the various prominent fertilizer constituents have been during the year within the usual limits. The most serious fluctuations were noticed in case of Chili saltpetre, nitrate of sodium, with a slight advance for corresponding months.

The duties assigned to the director of the station, to act as inspector of commercial fertilizers, render it necessary to *discriminate* in official publications of the results of analyses of commercial fertilizers and of manurial substances in general made at the station, *between analyses of samples collected by a duly qualified delegate of the experiment station, in conformity with the rules prescribed by the new laws, and those analyses which are made of samples sent on for that purpose by outside parties.* In regard to the former alone can the director assume the responsibility of a carefully prepared sample, and of the identity of the article in question.

The official report of analyses of compound fertilizers and of all such materials as are to be used for manurial purposes, which are sold in this State under a certificate of compliance with the present laws for the regulation of the trade in these articles, has been restricted by our State laws to a statement of chemical composition and to such additional information as relates to the latter.

The practice of affixing to each analysis of this class of fertilizers an approximate commercial valuation per ton of their principal constituents has, therefore, been discontinued. This change, it is expected, will tend to direct the attention of the consumers of fertilizers more forcibly towards a *consideration of the particular composition of the different brands of fertilizers offered for their patronage, a circumstance not unfrequently overlooked.*

The *approximate market value* of the different brands of fertilizers obtained by the current mode of valuation does not express *their respective agricultural value*, i. e., their crop-producing value; for the higher or lower market price of different brands of fertilizers does not necessarily stand in a direct relation to their particular fitness, without any reference to the particular condition of the soil to be treated and the special wants of the crops to be raised by their assistance.

To select judiciously from among the various brands of fertilizers offered for patronage requires, in the main, two kinds of information: namely, we ought to feel confident that the particular brand of fertilizer in question actually contains the guaranteed quantities and qualities of essential articles of plant food at a reasonable cost, and that it contains them in such form and such proportions as will best meet existing circumstances and special wants. In some cases it may be mainly either phosphoric acid or nitrogen or potash; in others, two of them; and in others again, all three. A remunerative use of commercial fertilizers can only be secured by attending carefully to the above-stated considerations.

To assist farmers not yet familiar with the current mode of determining the commercial value of manurial substances offered for sale in our markets, some of the essential considerations, which serve as a basis for their commercial valuation, are once more stated within a few subsequent pages.

The hitherto customary valuation of manurial substances is based on the average trade value of the essential fertilizing elements specified by analysis. The money value of the higher grades of agricultural chemicals and of the higher-priced compound fertilizers depends, in the majority of cases, on the amount and the particular form of two or three essential articles of plant food, i. e., phosphoric acid, nitrogen and potash, which they contain. To ascertain by this mode of valuation the approximate market value of a fertilizer (i. e., the money worth of its essential fertilizing ingredients), we multiply the pounds per ton of nitrogen, etc., by the trade value per pound; the same course is adopted with reference to the various forms of phosphoric acid and of potassium oxide. We thus get the values per ton of the several ingredients, and, adding them together, we obtain the total valuation per ton in case of cash payment at points of general distribution.

The market value of low-priced materials used for manurial purposes, as salt, wood ashes, various kinds of lime, barnyard manure, factory refuse and waste materials of different description, quite frequently does not stand in a close relation to the market value of the amount of essential articles of plant food they contain. Their cost varies in different localities. Local facilities for cheap transportation, and more or less advantageous mechanical condition for a speedy action, exert, as a rule, a decided influence on their selling price.

The mechanical condition of any fertilizing material, simple or compound, deserves the most serious consideration of farmers, when articles of a similar chemical character are offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility, and the more or less rapid diffusion of the different articles of plant food throughout the soil.

The state of moisture exerts a no less important influence on the pecuniary value in case of one and the same kind of substance. Two samples of fish fertilizers, although equally pure, may differ from fifty to one hundred per cent. in commercial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and refuse materials of various descriptions, have to be valued with reference to the market price of their principal constituents, taking into consideration at the same time their general fitness for speedy action.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals (1891).

	Cents per Pound.
Nitrogen in ammoniates,	18½
Nitrogen in nitrates,*	14½
Organic nitrogen in dry and fine ground fish, meat, blood,	15½
Organic nitrogen in cotton-seed meal and castor pomace,	15
Organic nitrogen in fine-ground bone and tankage,	15
Organic nitrogen in fine-ground medium bone and tankage,	12
Organic nitrogen in medium bone and tankage,	9½
Organic nitrogen in coarser bone and tankage,	7½
Organic nitrogen in hair, horn shavings and coarse fish scraps,	7
Phosphoric acid soluble in water,	8
Phosphoric acid soluble in ammonium citrate,	7½
Phosphoric acid in dry ground fish, fine bone and tankage,	7
Phosphoric acid in fine medium bone and tankage,	5½
Phosphoric acid in medium bone and tankage,	4½
Phosphoric acid in coarse bone and tankage,	3
Potash as high-grade sulphate, and in forms free from muriate or chlorides, ashes, etc.,	5½
Potash as kainite,	4½
Potash as muriate,	4½

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* The price of nitrate of soda has of late advanced, on account of the civil war in Chili.

The organic nitrogen in *superphosphates, special manures and mixed fertilizers of a high grade* is usually valued at the highest figures laid down in the trade values of fertilizing ingredients in raw materials, namely, fifteen and a half cents per pound; it being assumed that the organic nitrogen is derived from the best sources, viz., animal matter, as meat, blood, bones, or other equally good forms, and not from leather, shoddy, hair, or any low-priced, inferior form of vegetable matter, unless the contrary is ascertained. The insoluble phosphoric acid is valued in this connection at two cents.

The above trade values are the figures at which, in the six months preceding March, 1891, the respective ingredients could be bought at *retail for cash in our large markets, in the raw materials*, which are the regular source of supply.

They also correspond to the average wholesale prices for the six months ending March 1, plus about twenty per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to agree fairly with the retail price at the large markets of standard raw materials, such as: —

Sulphate of ammonia,
Nitrate of soda,
Muriate of potash,
Sulphate of potash,
Dried blood,
Dried ground meat,
Dry ground fish,
Azotin,
Ammonite,
Castor pomace,
Bone and tankage,
Plain superphosphates.

A large percentage of commercial materials consists of refuse matter from various industries. The composition of these substances depends on the mode of manufacture carried on. The rapid progress in our manufacturing industries is liable to affect at any time, more or less seriously, the composition of the refuse. To assist the farming community in a clear and intelligent appreciation of the various substances sold for manurial purposes, a frequent examination into the temporary characters of agricultural chemicals and refuse materials offered in our markets for manurial purposes is constantly carried on at the laboratory of the station.

Consumers of commercial manurial substances do well to buy, whenever practicable, on guarantee of composition with reference to their essential constituents, and to see to it that the bill of sale recognizes that point of the bargain. Any mistake or misunderstanding in the transaction may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article corresponding in its composition with the lowest stated quantity of each specified essential constituent.

Our present laws for the regulation of the trade in commercial fertilizers include not only the various brands of compound fertilizers, but also all materials, single or compound, without reference to source, used for manurial purposes, when offered for sale in our market at ten dollars or more per ton. Copies of our present laws for the regulation of the trade in commercial fertilizers may be had by all interested, on application, at the Massachusetts State Agricultural Experiment Station, Amherst, Mass.

2. *The Provisions of the Act are as follows:*

[CHAPTER 296.]

AN ACT TO REGULATE THE SALE OF COMMERCIAL FERTILIZERS.

Be it enacted, etc , as follows:

SECTION 1. Every lot or parcel of commercial fertilizer or material used for manurial purposes sold, offered or exposed for sale within this Commonwealth, the retail price of which is ten dollars or more per ton, shall be accompanied by a plainly printed statement clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand or trade mark under which the fertilizer is sold, the name and address of the manufacturer or importer, the place of manufacture, and a chemical analysis stating the percentage of nitrogen or its equivalent in ammonia, of potash soluble in distilled water, and of phosphoric acid in available form soluble in distilled water and reverted, as well as the total phosphoric acid. In the case of those fertilizers which consist of other and cheaper materials, said label shall give a correct general statement of the composition and ingredients of the fertilizer it accompanies.

SECT. 2. Before any commercial fertilizer, the retail price of which is ten dollars or more per ton, is sold, offered or exposed for sale, the importer, manufacturer or party who causes it to be sold or offered for sale within the state of Massachusetts, shall file with the director of the Massachusetts agricultural experiment station, a certified copy of the statement named in section one of this act, and shall also deposit with said director at his request a sealed glass jar or bottle, containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.

Sect. 3. The manufacturer, importer, agent or seller of any brand of commercial fertilizer or material used for manurial purposes, the retail price of which is ten dollars or more per ton, shall pay for each brand, on or before the first day of May annually, to the director of the Massachusetts agricultural experiment station, an analysis fee of five dollars for each of the three following fertilizing ingredients: namely, nitrogen, phosphorus and potassium, contained or claimed to exist in said brand or fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any person acting as agent or seller for such manufacturer or importer, such agent or seller shall not be required to pay the fee named in this section; and on receipt of said analysis fees and statement specified in section two, the director of said station shall issue certificates of compliance with this act.

Sect. 4. No person shall sell, offer or expose for sale in the state of Massachusetts, any pulverized leather, raw, steamed, roasted, or in any form as a fertilizer, or as an ingredient of any fertilizer or manure, without an explicit printed certificate of the fact, said certificate to be conspicuously affixed to every package of such fertilizer or manure and to accompany or go with every parcel or lot of the same.

Sect. 5. Any person selling, offering or exposing for sale, any commercial fertilizer without the statement required by the first section of this act, or with a label stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, or respecting the sale of which all the provisions of the foregoing section have not been fully complied with, shall forfeit fifty dollars for the first offence, and one hundred dollars for each subsequent offence.

Sect. 6. This act shall not affect parties manufacturing, importing or purchasing fertilizers for their own use, and not to sell in this state.

Sect. 7. The director of the Massachusetts agricultural experiment station shall pay the analysis fees, as soon as received by him, into the treasury of the station, and shall cause one analysis or more of each fertilizer or material used for manurial purposes to be made annually, and publish the results monthly, with such additional information as circumstances advise: *provided*, such information relates only to the composition of the fertilizer or fertilizing material inspected. Said director is hereby authorized in person or by deputy to take a sample, not exceeding two pounds in weight, for analysis, from any lot or package of fertilizer or any material used for manurial purposes which may be in the possession of any manufacturer, importer, agent or dealer; but said sample shall be drawn in the presence of said party or parties in interest or their representative, and taken from a parcel or a number of packages which shall be not less than ten per cent. of the whole lot inspected, and shall be thoroughly mixed and then divided into two equal samples and placed in glass vessels and carefully sealed and a label placed on each, stating the name or brand of the fertilizer or material sampled, the name of the party from whose stock the sample was drawn and the time and place of drawing, and said label shall also be signed by the director or his deputy and by the party or parties in interest or their representatives present at the drawing and sealing of said sample; one of said duplicate samples shall be retained by the director and the other by the party whose stock was sampled. All parties violating this act shall be prosecuted by the director of said station; but it shall be the duty of said director, upon ascertaining any violation of this act, to forthwith notify the manufacturer or importer in writing, and give him not less than thirty days thereafter in which to comply with the requirements of this act, but there shall be no prosecution in relation to the quality of the fertilizer or fertilizing material if the same shall be found substantially equivalent to the statement of analysis made by the manufacturer or importer.

Sect. 8. Sections eleven to sixteen inclusive of chapter sixty of the Public Statutes are hereby repealed.

Sect. 9. This act shall take effect on the first day of September in the year eighteen hundred and eighty-eight. [*Approved May 3, 1888.*]

Instructions to Manufacturers, Importers, Agents and Sellers of Commercial Fertilizers or Materials Used for Manurial Purposes in Massachusetts.

1. An application for a certificate of compliance with the regulations of the trade in commercial fertilizers and materials used for manurial purposes in this State must be accompanied: —

First, with a distinct statement of the name of each brand offered for sale.

Second, with a statement of the amount of phosphoric acid, of nitrogen and of potassium oxide guaranteed in each distinct brand.

Third, with the fee charged by the State for a certificate, which is five dollars for each of the following articles: nitrogen, phosphoric acid and potassium oxide guaranteed in any distinct brand.

2. The obligation to secure a certificate applies not only to compound fertilizers but to all substances, single or compound, used for manurial purposes, and offered for sale at ten dollars or more per ton of two thousand pounds.

3. The certificate must be secured annually before the first of May.

4. Manufacturers, importers and dealers in commercial fertilizers can appoint in this State as many agents as they desire, after having secured at this office the certificate of compliance with our laws.

5. Agents of manufacturers, importers and dealers in commercial fertilizers are held personally responsible for their transactions until they can prove that the articles they offer for sale are duly recorded in this office.

6. Manufacturers and importers are requested to furnish a list of their agents.

7. All applications for certificates ought to be addressed to the Director of the Massachusetts State Agricultural Experiment Station.

Arrangements are made, as in previous years, to attend to the examination of objects of general interest to the farming community, to the full extent of existing resources. Requests for analyses of substances — as fodder articles, fertilizers, etc. — coming through officers of agricultural societies and farmers' clubs within the State will receive hereafter, as in the past, first attention, and in the order that the applications arrive at the office of the station. The results will be returned without a charge for the services rendered. Application of private parties for analyses of substances, free of charge, will receive a careful consideration whenever the results promise to be of a more general interest. For obvious reasons, no work can be carried on at the station of which the results are not at the disposal of the managers for publication, if deemed advisable in the interest of the citizens of the State.

All parcels and communications sent to "The Massachusetts State Experiment Station" must have express and postal charges prepaid, to receive attention.

3. List of Dealers who have secured Certificates for the Sale of Commercial Fertilizers in this State during the Past Year, and the Brands licensed by Each.

Ames Fertilizer Company, Peabody, Mass. : —
- Animal Fertilizer.

E. Frank Coe, New York, N. Y. : —
- High-grade Ammoniated Bone Superphosphate.
- Gold Brand Excelsior Guano.
- Potato Fertilizer.
- Blue Brand Excelsior Guano.
- Red Brand Excelsior Guano.

Cleveland Linseed Company, Worcester, Mass. : —
- Steam-cooked Linseed Meal.

H. J. Baker & Bro., New York, N. Y. : —
- A. A. Ammoniated Superphosphate.
- Pelican Bone Fertilizer.
- Special Potato Manure.
- Special Grass Manure.

Whittemore Bros., Wayland, Mass. : —
- Whittemore's Complete Manure.

J. M. Butman, Lowell, Mass. : —
- Lowell Bone Fertilizer.

Edmund Hersey, Hingham, Mass. : —
- Ground Bone.

J. A. Tucker & Co., Boston, Mass. : —
- Original Bay State Bone Superphosphate.
- Imperial Bone Superphosphate.

J. C. Dow & Co., Boston, Mass. : —
- Nitrogenous Superphosphate.
- Ground Bone Fertilizer.
- Fine-ground Bone.

Cumberland Bone Company, Portland, Me. : —
- Cumberland Bone Superphosphate.
- Seeding-down Fertilizer.
- Potato Fertilizer.

3. List of Dealers who have secured Certificates, etc. — Continued.

- C. A. Bartlett, Worcester, Mass.: —
  - Pure Ground Bone.
  - Animal Fertilizer.
- Leander Wilcox, Mystic Bridge, Conn.: —
  - Dry Ground Fish Guano.
  - Potato Manure.
  - Ammoniated Bone Superphosphate.
  - High-grade Fish and Potash.
- W. E. Fyfe & Co., Clinton, Mass.: —
  - Unleached Wood Ashes.
- Daniel T. Church, Tiverton, R. I.: —
  - Fish and Potash.
  - Church's Special.
  - Church's Standard.
  - Pure Dry Ground Menhaden Guano.
- Williams & Clark Fertilizer Company, Boston, Mass.: —
  - Americus Superphosphate.
  - Potato Phosphate.
  - Bone Meal.
  - High-grade Special.
  - Tobacco Grower.
  - Sulphate of Potash.
  - Muriate of Potash.
  - Dry Ground Fish.
- Cleveland Dryer Company, Boston, Mass.: —
  - Cleveland Potato Phosphate.
  - Cleveland Superphosphate.
- W. D. Stewart & Co., Boston, Mass.: —
  - Soluble Pacific Guano.
  - Special Potato Manure.
- Munroe, Judson & Stroup, Oswego, N. Y.: —
  - Unleached Canada Wood Ashes.
- N. Ward Company, Boston, Mass.: —
  - High-grade Animal Fertilizer.
- Lister's Agricultural Chemical Works, Newark, N. J.: —
  - Standard Fertilizer, Success.
  - Ammoniated Dissolved Bone Phosphate.
  - Potato Fertilizer.
  - Ground Bone.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

G. E. Holmes, Worcester, Mass. : —
- Steamed Bone.

A. Lee & Co., Boston, Mass. : —
- Lawrence Fertilizer.
- Ground Bone.

Crocker Fertilizer and Chemical Company, Buffalo, N. Y. : —
- New Rival Ammoniated Superphosphate.
- Buffalo Superphosphate, No. 2.
- Special Potato Manure.
- Pure Ground Bone.
- Ammoniated Bone Superphosphate.
- Potato, Hop and Tobacco Phosphate.
- Queen City Phosphate.
- Vegetable Bone Superphosphate.
- Wheat and Corn Phosphate.
- Niagara Phosphate.
- Ammoniated Practical Phosphate.

F. C. Sturtevant, Hartford, Conn. : —
- Tobacco and Sulphur Fertilizer.

Read Fertilizer Company, Syracuse, N. Y. : —
- H. G. Farmers' Friend.
- Standard Phosphate.
- Bone, Fish and Potash.
- Strawberry and Small Fruit Special.

Bradley Fertilizer Company, Boston, Mass. : —
- X. L. Phosphate.
- B. D. Sea-fowl Guano.
- Coe's Original Superphosphate of Lime.
- Fish and Potash.
- Pure Fine-ground Bone.
- Bradley's Complete Manures : —
  - For Potatoes and Vegetables.
  - For Corn and Grain.
  - For Top-dressing Grass and Grain.
- Bradley's Potato Manure.
- Nitrate of Soda.
- Sulphate of Ammonia.
- Muriate of Potash.
- Dissolved Bone-black.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

Quinnipiac Fertilizer Company, New London, Conn. : —
- Quinnipiac Phosphate.
- Quinnipiac Potato Manure.
- Quinnipiac Dry Ground Fish.
- Quinnipiac Fish and Potash.
- Quinnipiac Market-garden Manure.
- Quinnipiac Bone Meal.
- Quinnipiac Tobacco Fertilizer.
- Muriate of Potash.
- Sulphate of Potash.

Standard Fertilizer Company, Boston, Mass. : —
- Standard Fertilizer.
- Standard Superphosphate.

Sanford Winter, Brockton, Mass. : —
- Pure Ground Bone.

Forest City Wood Ash Company, London, Ont. : —
- Unleached Wood Ashes.

Benjamin Randall, East Boston, Mass. : —
- Market-garden Fertilizer.
- Standard Ground Bone.

Great Eastern Fertilizer Company, Rutland, Vt. : —
- Great Eastern General, for Grain and Grass.
- Great Eastern Vegetable, Vine and Tobacco Fertilizers.
- Great Eastern General, Oats, Buckwheat and Seeding-down Phosphate.

E. H. Smith, Northborough, Mass. : —
- Steamed Bone.

John G. Jefferds, Worcester, Mass. : —
- Jefferds' Animal Fertilizer.
- Jefferds' Fine-ground Bone.

James E. McGovern, Lawrence, Mass. : —
- West Andover Market Bone Phosphate.
- Fine-ground Bone.

Thos. Hersom & Co., New Bedford, Mass. : —
- Meat and Bone.
- Pure Fine-ground Bone.

3. List of Dealers who have secured Certificates, etc. — Continued.

Adams & Thomas, Springfield, Mass. : —
  Adams' Market Bone Fertilizer.

Hargrave Manufacturing Company, Fall River, Mass. : —
  Steamed Bone.

Mapes Formula and Peruvian Guano Company, New York, N. Y. : —
  The Mapes Bone Manures.
  Peruvian Guano.
  Mapes Superphosphate.
  Mapes Special Crop Manures.

L. B. Darling Fertilizer Company, Pawtucket, R. I. : —
  Darling's Animal Fertilizer.
  Extra Bone Phosphate.
  Potato and Root Crop Manure.
  Fine Bone.
  Dissolved Bone.
  Fertilizer for Lawns and Gardens.

Bowker Fertilizer Company, Boston, Mass. : —
  Stockbridge Manures.
  Hill and Drill Phosphate.
  Lawn and Garden Phosphate.
  Ammoniated Bone Fertilizer.
  Fish and Potash.
  Dry Ground Fish.
  Gloucester Fish and Potash.
  Fresh Ground Bone.
  Plain Superphosphate.
  Kainite.
  Nitrate of Soda.
  Dried Blood.
  Dissolved Bone-black.
  Muriate of Potash.
  Sulphate of Potash.
  Breck's Lawn and Garden Dressing.

Lucien Sanderson, New Haven, Conn. : —
  Formula A.
  Pulverized Bone Meal.
  Dissolved Bone-black.
  Sulphate of Potash.

3. List of Dealers who have secured Certificates, etc. — Concluded.

Prentiss, Brooks & Co., Holyoke, Mass. : —
  H. L. Phelps' Complete Manures.
  Dry Fish.
  Muriate of Potash.
  Nitrate of Soda.
  Dissolved Bone-black.
  H. L. Phelps' Superphosphate.
  Fish and Potash.
  Guano and Potash.
  Tankage.

The Le Page Company, Boston, Mass. : —
  Red Star Brand 203 Fertilizer.
  Red Star Brand Special Potato Manure.

John S. Reese & Co., Baltimore, Md. : —
  Bay State Fertilizer.
  New England Favorite.
  Bay State Fertilizer, G. G.
  May Flower Guano.
  Pilgrim Fertilizer.
  Great Planet, A.
  Columbus, A.
  Potato and Corn.
  Fish and Potash.
  Dry Ground Fish.

Thomas Joynt, St. Helens, Ont. : —
  Canada Hardwood Ashes.

National Fertilizer Company, Bridgeport, Conn. : —
  Chittenden's Complete Fertilizer.
  Chittenden's Fish and Potash.
  Chittenden's Universal Phosphate.
  Ground Bone.

W. J. Brightman & Co., Tiverton, R. I. : —
  Fish and Potash.
  Ground Acidulated Fish Guano.
  Ammoniated Bone Superphosphate.

4. *Analyses of Commercial Fertilizers collected during 1891, in the General Markets, by the Agent of the Massachusetts Agricultural Experiment Station.*

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
1	Animal Fertilizer,	C. A. Bartlett, Worcester, Mass.,	Worcester.
5	Mapes Manure for Corn,	Mapes Formula and Peruvian Guano Company, New York,	Northampton.
6	Mapes Manure for Tobacco,	Mapes Formula and Peruvian Guano Company, New York,	Northampton.
7	Mapes Manure for Potatoes,	Mapes Formula and Peruvian Guano Company, New York,	Northampton.
11	Stockbridge's Manure for Onions,	Bowker Fertilizer Company, Boston, Mass.,	Northampton.
12	Stockbridge's Manure for Potatoes and Vegetables,	Bowker Fertilizer Company, Boston, Mass.,	Northampton.
15	Bradley's X. L. Superphosphate,	Bradley Fertilizer Company, Boston, Mass.,	Springfield.
16	Bradley's Potato Manure,	Bradley Fertilizer Company, Boston, Mass.,	Springfield.
18	Adams' Market Bone Fertilizer,	Adams & Thomas, Springfield, Mass.,	Springfield.
19	Quinnipiac Phosphate,	The Quinnipiac Company, Boston, Mass.,	Northampton.
20	Quinnipiac Fish and Potash (crossed fish brand),	The Quinnipiac Company, Boston, Mass.,	Northampton.
26	Quinnipiac Dry Ground Fish,	The Quinnipiac Company, Boston, Mass.,	Hatfield.
36	Lowell Bone Fertilizer,	J. M. Butman, Chelmsford, Mass.,	Chelmsford.
37	Animal Fertilizer,	Ames Fertilizer Company, Peabody, Mass.,	West Acton.
38	Chittenden's Complete Fertilizer for Potatoes, Roots and Vegetables,	National Fertilizer Company, Bridgeport, Conn.,	West Acton.
	Bones.		
2	Pure Ground Bone,	C. A. Bartlett, Worcester, Mass.,	Worcester.
3	Jefferds' Fine-ground Bone,	John G. Jefferds, Worcester, Mass.,	Worcester.
4	Fine-ground Bone,	Gilbert E. Holmes, Worcester, Mass.,	Worcester.
33	Bowker's Fresh Ground Bone,	Bowker Fertilizer Company, Boston, Mass.,	Concord.
40	Chittenden's Ground Bone,	National Fertilizer Company, Bridgeport, Conn.,	West Acton.
52	Ground Bone,	Edmund Hersey, Hingham, Mass.,	Hingham.
59	Steamed Bone,	E. H. Smith, Northborough, Mass.,	Amherst.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	NAME OF BRAND.	Moisture.	NITROGEN IN ONE HUNDRED POUNDS.		PHOSPHORIC ACID IN ONE HUNDRED POUNDS.							POTASSIUM OXIDE IN ONE HUNDRED POUNDS.	
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	TOTAL. Found.	TOTAL. Guaranteed.	AVAILABLE. Found.	AVAILABLE. Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
1	Animal Fertilizer,	5.06	5.30	3.3—4.12	.50	8.29	4.25	13.04	16—18	8.79	-	7.99	7—8
5	Mapes Manure for Corn,	4.95	3.60	3.71—4.12	4.99	4.68	.83	10.50	10—12	9.67	8—10	6.53	6—7
6	Mapes Manure for Tobacco,	11.95	5.64	6.18	.78	3.13	1.96	5.87	4.5	3.91	-	10.21	10.50*
7	Mapes Manure for Potatoes,	11.37	3.56	3.71—4.12	6.78	1.13	1.43	9.34	8—10	7.91	8	7.80	6—8*
11	Stockbridge's Manure for Onions,	11.45	3.10	3—4	4.11	5.32	1.61	11.04	8—10	9.43	7—8	5.75	5—6
12	Stockbridge's Manure for Potatoes and Vegetables,	10.34	3.48	3.25—4.25	4.72	4.68	2.06	11.46	8—10	9.40	7—8	5.48	5—6
15	Bradley's X. L. Superphosphate,	14.20	2.83	2.5—3.25	7.42	2.54	1.75	11.71	11—14	9.96	9—11	2.72	2—3*
16	Bradley's Potato Manure,	13.25	4.29	2.5—3.25	4.34	5.42	2.34	12.10	8—11	9.76	6—8	4.30	5—6*
18	Adams' Market Bone Fertilizer,	10.02	4.49	2.5—3.5	.61	6.46	3.80	10.87	8—10	7.07	6—8	4.85	3—5
19	Quinnipiac Phosphate,	14.15	2.95	2.47—3.3	5.55	4.65	1.02	11.22	10—15	10.20	9—12	2.41	2—3
20	Quinnipiac Fish and Potash (crossed fish brand),	20.16	3.60	3.3—4.12	.23	2.23	6.18	8.64	5—9	2.46	4—6	4.82	4—6*
26	Quinnipiac Dry Ground Fish,	9.26	8.60	7.41—9.06	.26	3.01	4.16	7.43	7—9	3.27	-	-	-
36	Lowell Bone Fertilizer,	13.23	2.46	2—2.5	6.17	3.78	1.05	11.00	10—16.5	9.95	9—13.5	2.94	2—3.5
37	Animal Fertilizer,	16.58	3.35	3.3—4.12	3.94	5.68	.40	10.02	9—12	9.62	8—10	3.22	2.75—3.5
38	Chittenden's Complete Fertilizer for Potatoes, Roots and Vegetables,	14.76	3.42	3.3—4.12	3.40	4.82	2.72	10.94	8—10	8.22	6—8	6.98	6—8

Laboratory Number.	NAME OF BRAND.	Moisture.	NITROGEN IN ONE HUNDRED POUNDS. Found.	NITROGEN Guaranteed.	PHOSPHORIC ACID. Soluble.	Reverted.	Insoluble.	TOTAL. Found.	TOTAL. Guaranteed.	AVAILABLE. Found.	AVAILABLE. Guaranteed.	MECHANICAL ANALYSIS. Fine.	Fine Medium.	Medium.	Coarse Medium.
	Bones.														
2	Pure Ground Bone,	5.40	2.77	2—3	.41	14.32	12.05	26.78	25—27	14.73	-	56.92	19.79	17.32	5.97
3	Jefferds' Fine-ground Bone,	10.39	1.85	2.47—4.12	.20	13.90	11.54	25.63	25—30	14.10	-	69.59	24.99	5.42	-
4	Fine-ground Bone,	4.40	2.71	2.5—3.5	.26	12.20	12.60	25.06	22—24	12.46	-	49.00	32.86	14.29	3.85
33	Bowker's Fresh Ground Bone,	9.76	3.17	2.47—3.3	2.69	12.17	4.18	19.04	18—22	14.86	5—7	45.29	25.30	22.35	7.06
40	Chittenden's Ground Bone,	6.06	3.80	2.88—3.71	.29	5.96	14.42	20.67	20—24	6.25	-	41.24	25.19	19.19	14.38
52	Ground Bone,	4.70	3.78	3—4	.29	6.65	14.35	21.29	19—25	6.94	-	46.87	37.72	14.04	1.37
59	Steamed Bone,	6.61	4.03	3.86	.25	5.00	17.21	22.46	22.69	5.25	5.84	49.19	27.20	21.16	2.45

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* Sulphate of potash, the source of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
28	Bowker's Hill and Drill Phosphate,	Bowker Fertilizer Company, Boston, Mass.,	Littleton.
35	Dow's Nitrogenous Superphosphate,	John C. Dow & Co., Boston, Mass.,	South Acton.
39	Chittenden's Ammoniated Bone Superphosphate,	National Fertilizer Company, Bridgeport, Conn.,	West Acton.
41	Original Bay State Bone Superphosphate,	J. A. Tucker & Co., Boston, Mass.,	Framingham.
42	Tobacco and Sulphur Lawn Fertilizer,	F. C. Sturtevant, Hartford, Conn.,	Concord.
46	Crocker's Ammoniated Wheat and Corn Phosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Framingham.
50	Cumberland Superphosphate,	Cumberland Bone Company, Portland, Me.,	West Acton.
60	Williams & Clark Fertilizer Company's Potato Phosphate,	Williams & Clark Fertilizer Company, Boston, Mass.,	Springfield.
72	Church's Fish and Potash (D brand),	Joseph Church & Co., Tiverton, R. I.,	Springfield.
74	Complete Potato Manure,	H. J. Baker & Bro., New York, N. Y.,	Springfield.
78	Great Eastern Vegetable, Vine and Tobacco Fertilizer,	Great Eastern Fertilizer Company, Rutland, Vt.,	Pittsfield.
79	E. Frank Coe's High-grade Ammoniated Bone Superphosphate,	E. Frank Coe, New York, N. Y.,	Lee.
88	Pilgrim Fertilizer,	John S. Reese & Co., Baltimore, Md.,	Pittsfield.
95	Pulverized Meat and Bone,	Lucien Sanderson, New Haven, Conn.,	Hadley.
104	Soluble Pacific Guano,	W. D. Stewart, Boston, Mass.,	Sunderland.
107	Bradley's High-grade Tobacco Manure,	Bradley Fertilizer Company, Boston, Mass.,	Sunderland.
109	Cleveland Potato Phosphate,	Cleveland Dryer Company, Boston, Mass.,	South Deerfield.
114	Pilgrim Fertilizer,	John S. Reese & Co., Baltimore, Md.,	Barre Plains.
115	Soluble Pacific Guano,	W. D. Stewart, Boston, Mass.,	Barre Plains.
127	Brightman & Co.'s Dry Ground Menhaden Fish Guano,	Wm. J. Brightman & Co., Tiverton, R. I.,	Fall River.
130	Meat and Bone,	Thos. Hersom & Co., New Bedford, Mass.,	New Bedford.
132	Tobacco and Sulphur Lawn Fertilizer,	F. C. Sturtevant, Hartford, Conn.,	New Bedford.
139	Whittemore's Complete Manure,	Whittemore Bros., Wayland, Mass.,	Wayland.
140	Standard Fertilizer,	Standard Fertilizer Company, Boston, Mass.,	Saxonville.
145	Church's Fish and Potash (D brand),	Joseph Church & Co., Tiverton, R. I.,	Taunton.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	NAME OF BRAND.	Moisture.	NITROGEN IN ONE HUNDRED POUNDS.		PHOSPHORIC ACID IN ONE HUNDRED POUNDS.							POTASSIUM OXIDE IN ONE HUNDRED POUNDS.	
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	TOTAL.		AVAILABLE.		Found.	Guaranteed.
								Found.	Guaranteed.	Found.	Guaranteed.		
	Compound Fertilizers.												
28	Bowker's Hill and Drill Phosphate, . . .	15.52	2.83	2.5—3.25	6.15	2.88	2.57	11.60	12—14	9.03	8—10	2.14	2—3
35	Dow's Nitrogenous Superphosphate, . .	16.48	2.34	2.06—2.88	3.97	5.17	2.32	11.46	-	9.14	8—10	3.14	3—4
39	Chittenden's Ammoniated Bone Superphosphate,	20.55	2.14	1.65—2.47	6.37	2.56	1.69	10.62	9—11	8.93	7—9	2.96	2—4
41	Original Bay State Bone Superphosphate, .	19.06	2.56	2.47—2.88	.91	6.78	3.30	10.99	10—12	7.69	9—9.5	2.78	2—3
42 132	Tobacco and Sulphur Lawn Fertilizer, . .	17.17	1.76	1.96	-	-	-	.81	.75	-	-	8.06	7.66
46	Crocker's Ammoniated Wheat and Corn Phos.,	17.25	3.12	2—3	5.56	5.36	4.14	15.06	-	10.92	10—13	3.10	1.75—2.92*
50	Cumberland Superphosphate, ...	16.20	3.30	2—3	4.62	5.60	3.88	14.10	12—14	10.22	9—12	3.14	2—3
60	Williams & Clark Fertilizer Co.'s Potato Phos.,	13.68	3.24	2.47—3.30	5.42	.78	2.65	8.85	-	6.20	6—9	5.55	5—6*
72 145	Church's Fish and Potash (D brand), . .	25.11	4.28	3.30—4.12	.84	4.30	1.05	6.19	5—6	5.14	-	4.32	3—4
74	Complete Potato Manure, ...	11.52	3.40	3.30	4.44	2.38	1.24	8.06	-	6.82	5.75	11.34	10
78	Great Eastern Vegetable, Vine and Tob. Fer.,	17.00	2.10	2.06—2.88	5.94	2.21	1.93	10.08	-	8.15	8—12	6.48	6—8
79	Coe's High-grade Ammoniated Bone Sup'rph.,	15.59	2.50	2—2.5	7.68	2.50	2.20	12.38	11—13	10.18	9—12	2.08	2*
88 114	Pilgrim Fertilizer, ...	7.56	1.56	1—1.45	3.70	5.20	1.77	10.67	7.5—11.5	8.90	6.5—8.5	3.51	2.5—3.5
95	Pulverized Meat and Bone, ...	1.95	5.85	4.94—5.77	.77	8.85	7.70	17.32	18—20	9.62	-	-	-
104 115	Soluble Pacific Guano, ...	16.27	3.00	2.25—3	7.22	2.68	2.02	11.92	10.5—16	9.90	8.5—12	4.64	3.70—6.50
107	Bradley's High-grade Tobacco Manure, . .	9.06	5.46	5.77—6.59	1.43	3.04	2.05	6.52	4—5	4.47	-	9.62	10.80—12.40*
109	Cleveland Potato Phosphate, ...	18.31	2.37	2.05—2.85	7.19	2.18	2.09	11.46	-	9.37	8—10	3.66	3.25—4.25*
127	Brightman & Company's Dry Gr. Men. F. G.,	10.51	7.96	8.24—9.89	1.15	3.43	3.77	8.35	6.87—9.16	4.58	-	-	-
130	Meat and Bone, ...	4.81	4.48	4.24	.38	6.85	11.55	18.78	19.52	7.23	6.73	-	-
139	Whittemore's Complete Manure, ...	15.90	2.58	2.47—3.30	4.41	8.45	3.28	16.14	18—14	12.86	8—12	4.68	3—4
140	Standard Fertilizer, ...	17.23	2.95	2—3	7.00	4.90	1.84	13.74	10—15	11.90	8—12	3.19	2—3*

* Sulphate of potash, the source of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	NAME OF BRAND.	NAME OF MANUFACTURER.	Sampled at —
	Compound Fertilizers.		
48	Bone Superphosphate for Vegetables,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Framingham.
54	Bowker's Bone-black,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
61	Ammoniated Bone Superphosphate (Americus Brand),	Williams & Clark Fertilizer Company, Boston, Mass.,	Springfield.
67	The H. L. Phelps Superphosphate,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
75	A. A. Ammoniated Superphosphate,	H. J. Baker & Bro., New York, N. Y.,	Springfield.
92	Dissolved Bone-black,	Lucien Sanderson, New Haven, Conn.,	Hadley.
99	Wilcox Potato Manure,	Leander Wilcox, Mystic, Conn.,	Amherst.
123	Darling's Animal Fertilizer,	Darling Fertilizer Co., Pawtucket, R. I.,	Worcester.
133	Strawberry Special,	Read Fertilizer Company, New York, N. Y.,	Dighton.
147	Fish and Potash,	John S. Reese & Co., Baltimore, Md.,	New Bedford.
150	Randall's Market-garden Fertilizer,	Benj. Randall, East Boston, Mass.,	East Boston.
155	Vegetable Bone Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Newburyport.
156	Red Star Brand Special Fertilizer for Potatoes, Cabbages, etc.,	Le Page Company, Boston, Mass.,	Boston.
162	Lister's Success Standard Fertilizer,	Lister Agricultural and Chemical Works, Newark, N. J.,	Lowell.
177	Huanillos Peruvian Guano,	Mapes Formula and Peruvian Guano Company, New York, N. Y.,	Boston.
185	Fish and Potash,	Read Fertilizer Company, Syracuse, N. Y.,	Northampton.
190	Lister's Ammoniated Dissolved Bone,	Lister Agricultural and Chemical Works, Newark, N. J.,	
	Bones.		
62	Fine Pure Ground Bone,	H. J. Baker & Bro., New York, N. Y.,	Springfield.
117	Pure Ground Bone,	Hargrave Manufacturing Company, Fall River, Mass.,	Fall River.
167	Lavery's Pure Ground Bone,	William Lavery, Amesbury, Mass.,	Amesbury.
170	West Andover Ground Bone,	James E. McGovern, Lawrence, Mass.,	Lawrence.
181	S. Winter's Pure Ground Bone,	Sanford Winter, Brockton, Mass.,	Brockton.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								Total.		Available.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
48 155	Bone Superphosphate for Vegetables,	11.64	5.52	5—6	3.42	4.11	1.30	8.83	-	7.53	6—7	6.72	6—8*
54	Bowker's Bone-black,	18.64	-	-	13.43	2.38	.59	16.40	-	15.81	15—18	-	-
61	Americus Brand Ammon. Bone Superphosphate,	14.42	2.68	2.47—3.30	7.77	1.75	2.46	11.98	-	9.52	9—11	1.90	2—3*
67	The H. L. Phelps Superphosphate,	15.72	2.62	2.47—3.30	9.11	-	.75	9.86	10—12	9.11	8—10	3.25	3—4
75	A. A. Ammoniated Superphosphate,	8.01	3.86	2.47—3.30	8.12	.27	1.10	9.49	-	8.39	10—12	2.03	2—3
92	Dissolved Bone-black,	17.30	-	-	15.94	.51	.46	16.91	-	16.45	16—18	-	-
99	Wilcox Potato Manure,	20.61	3.82	3.25—4.25	5.23	1.77	.52	7.52	8—9	7.00	7—8	6.10	6—7
123	Darling's Animal Fertilizer,	15.82	3.40	3.30—4.94	3.39	3.04	4.89	11.32	10—12	6.43	-	4.28	4—6
133	Strawberry Special,	17.50	3.62	3.30—4.94	3.61	1.49	2.10	7.20	6—8	5.10	5—6	6.80	6—8*
147	Fish and Potash,	14.04	4.00	2.47—4.11	6.79	2.70	1.54	11.03	7—10	9.49	6.5—8	4.64	3—5
150	Randall's Market-garden Fertilizer,	22.40	3.92	1.65—2.88	7.06	3.83	.82	11.71	10—16	10.89	8—11	2.09	2—4
156	Red Star Brand Special Fertilizer for Potatoes, etc.,	16.05	3.98	3—4	5.26	2.39	1.45	9.10	8—10	7.65	6—8	5.80	5—6*
162	Lister's Success Standard Fertilizer,	21.86	1.89	.91—1.65	8.32	2.11	1.07	11.50	10.5—12	10.43	-	1.53	1.5—2*
177	Huanillos Peruvian Guano,	14.63	1.18	1.58	.18	4.65	21.57	26.40	27.56	4.83	-	.25	.29
185	Fish and Potash,	19.31	2.60	2.47—3.30	3.36	.89	1.38	5.63	5—6	4.25	4—5	4.48	4—5*
190	Lister's Ammoniated Dissolved Bone,	11.89	2.48	1.81—2.06	6.67	2.18	5.35	14.20	11—13	8.85	9—10	1.69	2—3*

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen Found.	Nitrogen Guaranteed.	Soluble.	Reverted.	Insoluble.	Total Found.	Total Guaranteed.	Available Found.	Available Guaranteed.	Mechanical Analysis. Fine.	Fine Medium.	Medium.	Coarse Medium.
	Bones.														
62	Fine Pure Ground Bone,	10.03	3.34	3.30—3.91	-	2.37	21.62	23.97	22—26	2.35	-	.03	10.79	82.40	6.78
117	Pure Ground Bone,	6.68	2.88	2.50—2.80	.67	13.75	10.69	25.13	25—27	14.44	-	36.37	22.23	18.60	22.80
167	Lavery's Pure Ground Bone,	9.25	2.52	-	.18	9.16	5.97	15.31	-	9.34	-	47.05	32.38	18.51	2.06
170	West Andover Ground Bone,	10.24	2.02	-	-	12.76	10.59	23.35	-	12.76	-	63.20	26.60	8.34	1.86
181	S. Winter's Pure Ground Bone,	8.07	2.56	3.16	.45	12.26	13.29	26.00	23.60	12.71	11.28	53.72	26.35	15.73	4.20

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* Sulphate of potash, the source of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Name of Manufacturer.	Sampled at —
	Compound Fertilizers.		
66	Fish and Potash,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
69	Tankage,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
77	New Rival Ammoniated Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Pittsfield.
84	Extra Fine-ground Bone with Potash (circle brand),	Bradley Fertilizer Company, Boston, Mass.,	Pittsfield.
89	Reese's May Flower Guano,	John S. Reese & Co., Baltimore, Md.,	Pittsfield.
93	Blood, Meat and Bone,	Lucien Sanderson, New Haven, Conn.,	Hadley.
102	Wilcox's Dry Ground Fish Guano,	Leander Wilcox, Mystic, Conn.,	Amherst.
112	Blue Brand Excelsior Guano,	E. Frank Coe, New York, N. Y.,	South Deerfield.
122	Reese's May Flower,	John S. Reese & Co., Baltimore, Md.,	Barre Plains.
124	Complete Grass Manure,	H. J. Baker & Bro., New York, N. Y.,	Fall River.
128	Fish Pomace,	W. J. Brightman & Co., Tiverton, R. I.,	Taunton.
138	Quinnipiac Market Garden Fertilizer,	The Quinnipiac Company, Boston, Mass.,	Fall River.
148	Dry Ground Fish,	John S. Reese & Co., Baltimore, Md.,	New Bedford.
166	Bowker's Lawn and Garden Dressing,	Bowker Fertilizer Company, Boston, Mass.,	Woburn.
172	Dow's Ground Bone Fertilizer,	John C. Dow & Co., Boston, Mass.,	Boston.
175	Standard Guano,	Standard Fertilizer Company, Boston, Mass.,	Boston.
186	B. D. Sea Fowl Guano,	Bradley Fertilizer Company, Boston, Mass.,	Greenfield.
	Bones.		
80	Pure Ground Bone,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Lee.
86	Quinnipiac Pure Bone Meal,	The Quinnipiac Company, Boston, Mass.,	Williamstown.
91	Quinnipiac Pure Bone Meal,	The Quinnipiac Company, Boston, Mass.,	Springfield.
131	Pure Fine-ground Bone,	Thos. Hersom & Co., New Bedford, Mass.,	New Bedford.
151	Standard Ground Bone,	Benj. Randall, East Boston, Mass.,	East Boston.
154	Pure Ground Bone,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Newburyport.
161	Lister's Celebrated Ground Bone,	Lister Agricultural and Chemical Works, Newark, N. J.,	Lowell.
192	Dow's Ground Bone,	John C. Dow & Co., Boston, Mass.,	

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	NAME OF BRAND.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								TOTAL.		AVAILABLE.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
66	Fish and Potash,	9.91	4.38	3.30—4.12	1.46	2.15	1.97	5.58	5—6	3.61	-	4.80	4—5
69	Tankage (Prentiss, Brooks & Co.),	5.14	6.32	5.77	-	7.04	3.07	10.11	10—11	7.04	-	-	-
77	New Rival Ammoniated Superphosphate,	13.81	1.39	1.2—2.05	3.40	6.20	2.83	12.43	-	9.60	10—12	2.27	1.6—2.7*
84	Bone and Potash (Bradley),	10.86	2.34	1.85—2.68	.99	4.74	6.83	12.56	8—12	5.73	-	2.22	2—3
89	Reese's May Flower Guano,	15.46	2.10	1.65—2.06	2.97	7.70	.86	11.53	9.5—12.5	10.67	8—9	1.93	2—2.5
93	Blood, Meat and Bone,	6.00	6.46	5.77—7.41	.26	5.30	5.40	10.96	10—12	5.56	-	-	-
102	Wilcox's Dry Ground Fish Guano,	8.32	8 76	8—10	.77	4.21	3.12	8.10	-	4.98	4—6	-	-
112	Blue Brand Excelsior Guano,	10.06	6.08	6—7	6.40	1.82	2.05	10.27	-	8.22	7—10	3.56	3*
122	Reese's May Flower,	9.25	2.00	1.8—2.05	3.08	6.95	.93	10.96	10—13	10.03	8.5—10	2.49	2.25—3
124	Baker's Complete Grass Manure,	13.26	3.24	3.71	6.05	.41	.26	6.72	5	6.46	-	8.95	7.5
128	Brightman's Fish Pomace,	38.09	4.87	-	.19	.64	2.85	3.68	-	.83	-	-	-
138	Quiuuipiac Market Garden Fertilizer,	12.33	3.44	3.30—4.12	7.45	1.94	1.37	10.76	9—13	9.39	8—11	7.14	7—8*
148	Reese's Dry Ground Fish,	7.38	8.72	8.65	.41	2.40	4.55	7.36	-	2.81	-	-	-
166	Bowker's Lawn and Garden Dressing,	12.87	4.02	4—5	5.88	2.23	2.02	10.13	6—8	8.11	5—6	6.88	5—6*
172	Dow's Ground Bone Fertilizer,	3.80	2.46	2.06—2.47	.84	5.97	14.35	21.16	18—22	6.81	-	3.53	3—4
175	Standard Guano,	16.89	2.29	1—2	7.06	3.19	1.28	11.53	10—15	10.25	8—12	2.08	2—3*
186	B. D. Sea Fowl Guano,	15.75	2.58	2.5—3.25	6.63	3.28	2.35	12.26	11—14	9.91	9—11	2.03	2—3*

Laboratory Number.	NAME OF BRAND.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Mechanical Analysis.			
								TOTAL.		AVAILABLE.					
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Fine.	Fine Medium.	Medium.	Coarse Medium.
	Bones.														
80 154	Crocker's Pure Ground Bone,	7.51	3.74	2.9—3.7	.23	4.94	17.35	22.52	25	5.17	-	23.17	31.76	26.06	19.01
86 91	Qniunipiac Pure Bone Meal,	11.93	2.49	2.47—4.12	.10	6.08	15.38	21.56	20—25	6.18	-	62.67	35.32	2.01	-
131	Pure Fine-ground Bone,	7.59	2.00	2.8	.50	8.91	19.80	29.21	29.42	9.41	13.62	62.59	16.67	17.40	3.34
151	Standard Ground Bone,	11.89	2.64	2—3	3.04	5.94	5.26	14.24	14—16	8.98	5—7	35.18	40.25	30.32	4.25
161	Lister's Celebrated Ground Bone,	8.05	2.90	2.7—2.9	.32	4.95	6.88	12.15	12—14	5.27	-	38.75	29.10	17.15	15.00
192	Dow's Ground Bone,	5.80	1.81	1.65—2.47	.16	8.21	18.06	26.43	24—26	8.37	-	64.17	35.83	-	-

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* Sulphate of potash, the source of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	NAME OF BRAND	NAME OF MANUFACTURER.	Sampled at —
	Compound Fertilizers.		
13	Stockbridge's Manure for Top-dressing,	Bowker Fertilizer Company, Boston, Mass.,	Northampton.
17	Hampden Lawn Dressing,	Bradley Fertilizer Company, Boston, Mass.,	Springfield.
32	Stockbridge's Manure for Top-dressing,	Bowker Fertilizer Company, Boston, Mass.,	Littleton.
34	Stockbridge's Manure for Strawberries and Small Fruits,	Bowker Fertilizer Company, Boston, Mass.,	Concord.
44	English Lawn Dressing,	Bradley Fertilizer Company, Boston, Mass.,	Lowell.
47	Crocker's Special Potato Manure,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	Framingham.
49	Ammoniated Bone Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	South Acton.
63	The H. L. Phelps' Complete Manure for Grass,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
71	Guano and Potash,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
81	Crocker's Special Potato Manure,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	North Adams.
82	Quinnipiac Potato Manure,	The Quinnipiac Company, Boston, Mass.,	Williamstown.
83	Ammoniated Bone Superphosphate,	Crocker Fertilizer and Chemical Company, Buffalo, N. Y.,	North Adams.
87	Stockbridge's Manure for Seeding Down,	Bowker Fertilizer Company, Boston, Mass.,	Pittsfield.
98	Quinnipiac Grass Fertilizer,	The Quinnipiac Company, Boston, Mass.,	Williamstown.
100	Wilcox's High-grade Fish and Potash,	Leander Wilcox, Mystic, Conn.,	Amherst.
101	Wilcox's Ammoniated Bone Phosphate,	Leander Wilcox, Mystic, Conn.,	Amherst.
105	Bradley's Complete Manure for Top-dressing,	Bradley Fertilizer Company, Boston, Mass.,	Sunderland.
106	Bradley's Complete Manure for Potatoes and Vegetables,	Bradley Fertilizer Company, Boston, Mass.,	Sunderland.
110	Cleveland Superphosphate,	Cleveland Dryer Company, Boston, Mass.,	South Deerfield.
111	Red Brand Excelsior Guano,	E Frank Coe, New York, N. Y.,	South Deerfield.
113	Bay State Fertilizer G. G.,	John S. Reese & Co., Baltimore, Md.,	Barre Plains.
116	Concentrated Potato and Corn Manure,	John S. Reese & Co., Baltimore, Md.,	Barre Plains.
118	Church's Special Fertilizer,	Joseph Church & Co., Tiverton, R. I.,	Dighton.
120	Darling's Fertilizer for Gardens and Lawns,	Darling Fertilizer Company, Pawtucket, R. I.,	Worcester.
129	Church's Pure Dry Fish,	Joseph Church & Co., Tiverton, R. I.,	Dighton.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	Name of Brand.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
								TOTAL.		AVAILABLE.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
13 32	Stockbridge's Manure for Top-dressing,	5.76	5.05	5—6	3.20	.83	6.33	10.36	6—7	4.03	3—4	6.51	5—6
17	Hampden Lawn Dressing,	9.40	4.54	3.30—4.12	2.53	2.77	1.33	6.63	7—9	5.30	6—8	2.23	2—3
34	Stockbridge's Manure for Strawberries and Small Fruits,	10.47	3.08	2.50—3.25	7.01	1.28	2.51	10.80	7—9	8.29	6—7	3.18	4.32—5.40*
44	English Lawn Fertilizer,	8.94	5.10	4.95—5.78	2.99	2.88	1.09	6.96	6—8	5.87	5—7	3.01	2.50—3.50
47 81	Crocker's Special Potato Manure,	11.58	3.36	3.70—4.50	5.44	1.23	2.00	8.67	9—11	6.67	8—9	6.97	5—6*
49 83	Ammoniated Bone Superphosphate,	11.45	2.60	2.90—3.70	4.96	3.23	3.91	12.10	10—12	8.19	10—13	1.76	1—2*
63	The H. L. Phelps' Complete Manure for Grass,	11.62	4.70	4.12—4.94	4.91	1.73	.47	7.11	6—8	6.64	3—4	7.76	8—10
71	Guano and Potash,	11.65	3.64	3.30—4.12	1.07	3.34	2.97	7.38	5—6	4.41	-	5.03	5—7
82	Quinnipiac Potato Manure,	14.52	3.10	2.47—3.30	2.88	3.09	3.71	9.68	7—11	5.97	6—9	4.90	5—6*
87	Stockbridge's Manure for Seeding Down,	11.95	2.36	2.47—3.30	5.27	5.27	2.30	12.84	12—14	10.54	6—8	8.38	5.05—6.32
98	Quinnipiac Grass Fertilizer,	12.91	3.58	3.30—4.12	4.25	1.80	2.69	8.74	7—10	6.05	6—8	4.81	5—7*
100	Wilcox's High-grade Fish and Potash,	22.50	4.00	3.25—4.25	2.65	1.89	2.05	6.59	6—7	4.54	5—6	4.21	4—5
101	Wilcox's Ammoniated Bone Phosphate,	21.50	4.00	3.25—4.25	3.63	2.05	2.10	7.78	7—8	5.68	6—7	5.07	5—6
105	Bradley's Complete Manure for Top-dressing,	8.21	5.16	6—7	1.92	2.78	2.02	6.72	6—9	4.70	5—7	2.90	2.50—3.50*
106	Bradley's Complete Manure for Potatoes and Vegetables,	11.36	4.08	3.73—4.52	4.30	5.06	2.56	11.92	9—13	9.36	8—11	4.72	6—7
110	Cleveland Superphosphate,	14.62	2.80	2.05—2.85	5.82	2.88	2.94	11.65	11—14	8.70	9—11	2.26	2—3*
111	Red Brand Excelsior Guano,	12.33	2.96	3.50—4	7.00	.18	3.28	10.46	10—14	7.18	9—12	5.08	6*
113	Bay State Fertilizer G. G.,	19.33	1.92	1.80—2.50	2.61	8.16	.77	11.54	10—13	10.77	8.5—10	2.34	2.25—3
116	Concentrated Potato and Corn Manure,	15.61	3.28	2.97—3.80	3.83	4.63	.42	8.88	7—10	8.46	6—8	7.61	7.50—9.50
118	Church's Special Fertilizer,	13.99	5.16	4.94—5.77	4.35	2.77	1.96	9.08	12—13	7.12	-	6.72	6—7
120	Darling's Fertilizer for Gardens and Lawns,	10.53	5.08	4.94—6.59	1.69	6.53	3.89	12.11	10—12	8.22	-	4.95	5—6
129	Church's Pure Dry Fish,	10.10	9.35	8.24—9.89	.10	4.06	3.16	7.32	6.87—11.45	4.16	-	-	-

* Sulphate of potash, the source of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

Laboratory Number.	NAME OF BRAND.	NAME OF MANUFACTURER.	Sampled at —
	Compound Fertilizers.		
29	Stockbridge's Manure for Corn, Grain and Fodder Corn,	Bowker Fertilizer Company, Boston, Mass.,	Littleton.
103	Gold Brand Excelsior Guano,	E. Frank Coe, New York, N. Y.,	Sunderland.
143	Bradley's Dry Ground Fish Guano,	Bradley Fertilizer Company, Boston, Mass.,	Taunton.
144	Bradley's Fish and Potash,	Bradley Fertilizer Company, Boston, Mass.,	Taunton.
146	New England Favorite,	John S. Reese & Co., Baltimore, Md.,	New Bedford.
149	Columbus A. Manure,	John S. Reese & Co., Baltimore, Md.,	New Bedford.
153	The Lawrence Fertilizer,	A. Lee & Co., Lawrence, Mass.,	Lawrence.
163	Williams & Clark Company's Royal Bone Phosphate,	Williams & Clark Fertilizer Company, Boston, Mass.,	Lowell.
164	Williams & Clark Company's Prolific Crop Producer,	Williams & Clark Fertilizer Company, Boston, Mass.,	Lowell.
171	Breck's Lawn and Garden Dressing,	Bowker Fertilizer Company, Boston, Mass., Licensees,	Boston.
173	Mayo's Superphosphate,	Clarence E. Mayo & Co., Boston, Mass.,	Woburn.
174	N. Ward Company's High-grade Animal Fertilizer,	The N. Ward Company, Boston, Mass.,	Boston.
182	Read's Standard Phosphate,	Read Fertilizer Company, Syracuse, N. Y.,	Greenfield.
184	High-grade Farmers' Friend,	Read Fertilizer Company, Syracuse, N. Y.,	Northampton.
	Chemicals.		
21	Dissolved Bone-black,	Quinnipiac Fertilizer Company, Boston, Mass., Licensees,	Northampton.
23	Muriate of Potash,	Quinnipiac Fertilizer Company, Boston, Mass., Licensees,	Northampton.
55	High-grade Sulphate of Potash,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
57	Sulphate of Ammonia,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
58	Nitrate of Soda,	Bowker Fertilizer Company, Boston, Mass.,	Amherst.
65	Dissolved Bone-black,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
70	Muriate of Potash,	Prentiss, Brooks & Co., Holyoke, Mass.,	Holyoke.
94	Sulphate of Potash,	Lucien Sanderson, New Haven, Conn.,	Hadley.
96	Muriate of Potash,	Lucien Sanderson, New Haven, Conn.,	Hadley.
	Wood Ashes.		
14	Canada Wood Ashes,	Forest City Wood Ash Company, London, Ontario, Canada,	South Deerfield.
51	Canada Wood Ashes,	Wm. E. Fyfe & Co., Clinton, Mass., Licensees,	Concord.
180	Unleached Canada Wood Ashes,	Monroe, Judson & Stroup, Oswego, N. Y.,	N. Amherst City.
189	Canada Hard-wood Ashes,	Thomas Joynt, St. Helen's, Ontario, Canada,	Northampton.

4. *Analyses of Commercial Fertilizers, etc.* — Concluded.

Laboratory Number.	NAME OF BRAND.	Moisture.	NITROGEN IN ONE HUNDRED POUNDS.		PHOSPHORIC ACID IN ONE HUNDRED POUNDS.							POTASSIUM OXIDE IN ONE HUNDRED POUNDS.	
								TOTAL.		AVAILABLE.			
			Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
	Compound Fertilizers.												
29	Stockbridge's Manure for Corn, Grain and Fodder Corn,	12.86	3.30	3.25—4.25	5.63	2.97	2.61	11.21	9—11	8.60	8—9	4.83	4.42—5.69
103	Gold Brand Excelsior Guano,	10.62	2.86	2.5—3	5.88	5.56	2.25	13.69	-	11.44	8—11	5.03	6—8*
143	Bradley's Dry Ground Fish Guano,	9.08	8.54	8.24—9.89	.58	3.42	4.80	8.80	6—8	4.00	-	-	-
144	Bradley's Fish and Potash,	19.51	3.20	2.48—3.50	3.79	2.91	1.82	8.52	7.5—9.5	6.70	6—8	2.35	2—3*
146	New England Favorite,	18.45	3.30	2.47—3.30	3.07	6.89	.79	10.75	10—14	9.96	9—12	2.62	2—3
149	Columbus A. Manure,	14.65	3.63	3.29—4.11	3.33	3.68	1.05	8.06	8—11	7.01	7—9	9.40	9.5—11
153	The Lawrence Fertilizer,	12.96	2.71	2.06—2.88	6.12	4.37	1.84	12.33	10—12	10.49	-	2.82	2—3
163	Williams & Clark Co.'s Royal Bone Phosphate,	17.18	1.58	1.03—1.65	3.43	3.00	3.15	9.58	8—11	6.43	7—9	2.13	2—3*
164	Williams & Clark Co.'s Prolific Crop Producer,	15.70	1.96	.82—1.65	4.95	3.33	2.10	10.38	7—11	8.28	6—9	1.65	1—2*
171	Breck's Lawn and Garden Dressing,	9.21	4.02	4.12—4.94	6.01	1.73	5.03	12.77	-	7.74	5—6	4.95	5—6
173	Mayo's Superphosphate,	13.67	2.84	2.05—2.85	6.65	3.43	2.61	12.69	10—14	10.08	9—11	2.82	2.5—3.5
174	N. Ward Co.'s High-grade Animal Fertilizer,	6.80	3.55	2.88—3.70	6.18	6.34	.70	13.22	-	12.52	12—14	4.41	4—5
182	Read's Standard Phosphate,	15.62	1.48	.82—1.65	7.01	1.73	1.15	9.89	10—12	8.74	8—10	3.08	4—6*
184	High-grade Farmers' Friend,	11.96	3.45	3.30—4.12	3.68	2.18	3.02	8.88	-	5.86	5—6	9.46	10—11
	Chemicals.												
21	Dissolved Bone-black,	18.82	-	-	12.84	1.81	.38	15.03	-	14.65	15—18	-	-
23	Muriate of Potash,	1.13	-	-	-	-	-	-	-	-	-	49.00	50.54—53.70
55	High-grade Sulphate of Potash,	1.55	-	-	-	-	-	-	-	-	-	48.32	51.88
57	Sulphate of Ammonia,	2.53	19.98	19.77—20.57	-	-	-	-	-	-	-	-	-
58	Nitrate of Soda,	1.81	15.76	15.65—16.14	-	-	-	-	-	-	-	-	-
65	Dissolved Bone-black,	17.73	-	-	16.14	.27	.14	16.45	-	16.41	17.50	-	-
70	Muriate of Potash,	1.35	-	-	-	-	-	-	-	-	-	51.72	53.70
94	Sulphate of Potash,	3.77	-	-	-	-	-	-	-	-	-	26.52	27.02—29.72
96	Muriate of Potash,	1.33	-	-	-	-	-	-	-	-	-	50.64	50.54—53.70
	Wood Ashes.												
14	Canada Wood Ashes,	11.15	-	-	-	-	-	1.65	1.5—2.5	-	-	5.37	4.5—8
51	Canada Wood Ashes,	4.70	-	-	-	-	-	1.02	1—3	-	-	7.00	5—8
180	Unleached Canada Wood Ashes,	24.69	-	-	-	-	-	1.56	1—2.5	-	-	4.48	4.5—7
189	Canada Hard-wood Ashes,	16.52	-	-	-	-	-	1.57	-	-	-	4.64	5—7

* Sulphate of potash, the source of potash.

Methods of Fertilizer Analysis.

Preparation of Sample. — The entire available sample is spread upon a smooth, hard surface, and intimately mixed without grinding, all lumps being broken up with a spatula. Unnecessary loss or gain of moisture is to be avoided. *Moisture:* dry 2 grams in the air-bath at 100 to 110° C. to constant weight.

1. Total Phosphoric Acid. — Weigh out 2 grams in a platinum crucible, and destroy the organic matter by carefully burning in a muffle. Weigh when cool, to determine the "organic and volatile matter." Digest the crucible and contents with dilute hydrochloric acid, until the solution of the latter is complete. Filter, and evaporate the filtrate to complete dryness. The "insoluble matter" on the filter is burned and weighed. The residue left from the evaporation is taken up with dilute nitric acid, if the molybdic method is to be followed, but with hydrochloric acid if method (2) is preferred. The solution after filtering is made up to a volume of 200 cubic centimetres with distilled water.

(1) The molybdic method: 25 cubic centimetres of the solution are digested in a water-bath at 65° C. from one to two hours, with an excess of molybdic solution. The precipitate is brought upon a filter, and washed with water containing a little molybdic solution. It is then dissolved in ammonia water, the solution nearly neutralized with hydrochloric acid, and magnesia mixture added slowly, with constant stirring. The precipitate is allowed to stand at least three hours, when it is filtered through a Gooch crucible, washed with dilute ammonia, ignited and weighed.

(2) The following method is occasionally employed when phosphates of iron and alumina are present in small quantities only: To 50 cubic centimetres of the hydrochloric acid solution add ammonia in slight excess. After standing a few minutes, acidify with acetic acid, and filter off the phosphates of iron and alumina, washing carefully with water. To the filtrate add sufficient oxalate of ammonia to precipitate all the lime; digest for several hours at a temperature below boiling, and filter through double filters which have previously been washed with oxalate of ammonia, washing

thoroughly with water. Dissolve the phosphates of iron and alumina on the filter with warm dilute hydrochloric acid, and wash into a beaker containing a small quantity of powdered tartaric acid. When the latter has gone into solution, mix with the filtrate from the oxalate of ammonia. The phosphoric acid is precipitated with magnesia mixture, and treated as in (1).

Soluble phosphoric acid: Weigh out 2 grams into a beaker, cover with 10 to 15 cubic centimetres of water, and allow it to stand for fifteen minutes, stirring three times at equal intervals. Decant the solution through a filter into a graduated cylinder. Add another like quantity of water, and let it stand fifteen minutes more, stirring as before. Filter the solution into the cylinder, and wash the residue on the filter until the filtrate amounts to 200 cubic centimetres. The phosphoric acid is determined in an aliquot part of the solution as under total phosphoric acid.

Insoluble phosphoric acid: Add 100 cubic centimeters of neutral ammonia citrate (sp. gr. 1.09) to the beaker in which the digestion with water has been made. Put in a water-bath and heat to 65° C. Drop in the filter containing the residue from the above operation, and digest for thirty minutes, stirring every five minutes. Filter and wash thoroughly, using the suction pump. Dry, and burn. The ash is then treated as under total phosphoric acid.

Reverted phosphoric acid: The sum of the soluble and insoluble substracted from the total gives the reverted or citrate-soluble phosphoric acid.

Reagents: The reagents used in the estimation of phosphoric acid are prepared according to directions given in the "Proceedings of the Association of Official Agricultural Chemists," 1890 (pages 228 and 229).

For ammonium citrate, 370 grams of citric acid are dissolved in 1,500 cubic centimetres of water, nearly neutralized with crushed carbonate of ammonia, heated to expel carbonic acid, exactly neutralized with ammonia, and brought to a specific gravity of 1.09.

The molybdic solution is prepared by dissolving 100 grams of molybdic acid in 417 cubic centimetres of ammonia of specific gravity .96. Pour this solution into 1,250 cubic centimetres of nitric acid of specific gravity 1.20, and set in a warm place for several days, or until a portion heated to 40° C. deposits no yellow precipitate.

The magnesia mixture is prepared by dissolving 110 grams of crystallized magnesium chloride and 280 grams of ammonium chloride in 700 cubic centimetres of ammonia of specific gravity .96, and bringing to a volume of two liters.

2. *Methods of Determining Nitrogen.* — The Kjeldahl and soda-lime methods recommended by the Association of Official Agricultural Chemists, in their "Proceedings," 1890, pages 190 and 191, are employed, with occasional control analyses by the absolute cupric oxide mode.

3. *Method for Determining Potash.* — Weigh out two grams of the material in a platinum crucible, and char thoroughly at a temperature just below red heat. Digest for several hours with very dilute hydrochloric acid, on the water-bath. Filter into a graduated cylinder, and make up to 200 cubic centimetres. Take 50 cubic centimetres for each test. Warm, and add in small quantities at a time, an excess of barium hydrate. Digest for one or two hours at a temperature of 70° to 90° C., filter, washing carefully, and add to the filtrate a few drops of ammonium hydrate, and enough ammonium carbonate to precipitate the excess of barium hydrate. Filter, and bring the filtrate to dryness on the water-bath in a platinum dish. Heat carefully in the covered platinum dish at a temperature just below red heat, until compounds of ammonia cease to come off. Take up the residue in water, filtering if necessary, and add an excess of platinum tetrachloride. Evaporate to dryness on the water-bath, add a small quantity of 80 per cent. alcohol, and allow it to stand for a few hours. Filter through a Gooch crucible, washing with alcohol, dry, and weigh; or filter through paper, wash as before, dry, and brush the potassium platinic chloride upon a weighed watch glass, with a camel's-hair brush, and weigh. If very impure, the double salt is washed with the strong solution of ammonium chloride, saturated with potassium platinic chloride, as recommended in the "Proceedings of the Association of Official Agricultural Chemists," 1890, page 210.

5. Analyses of Commercial Fertilizers and Manurial Substances sent on for Examination.

Wood Ashes.

[I., Canada wood ashes, sent on from Stow, Mass ; II , Home-made ashes, sent on from Stow, Mass.; III. and IV., sent on from North Amherst, Mass.; V., sent on from North Hatfield, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100 C , ...	14.88	0.25	29.49	30.69	8.68
Calcium oxide, ...	33.42	37.16	28.79	24.75	33.19
Magnesium oxide, ...	2.89	6.31	3.74	2.04	4.21
Ferric oxide, ...	1.03	2.26	0.84	0.97	1.03
Potassium oxide, ...	6.17	6.58	2.32	2.78	6.58
Phosphoric acid, ...	2.19	5.58	1.58	1.84	2.01
Insoluble matter (before calcination).	13.67	27.45	11.72	16.66	14.66
Insoluble matter (after calcination),	11.07	22.93	10.37	13.08	12.21

Wood Ashes.

[I., sent on from Lawrence, Mass ; II , sent on from Hadley, Mass.; III., sent on from Hudson, Mass.; IV., sent on from Clifton, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C..	8.71	13.18	18.00	15.94
Calcium oxide, ...	36.95	34.06	33.25	31.65
Magnesium oxide, ...	2.90	2.88	1.84	2.59
Ferric oxide, ...	0.07	1.32	1.42	1.62
Potassium oxide, ...	5.77	4.56	4.51	4.71
Phosphoric acid, ...	1.38	1.66	1.18	1.43
Insoluble matter (before calcination),	13.15	13.60	12.99	13.38
Insoluble matter (after calcination), .	11.88	11.16	10.84	10.62

5. *Analyses, etc.* — Continued.

Wood Ashes.

[I., from North Amherst, Mass.; II., from North Hadley, Mass.; III., Railroad tie ashes, from Winchester, Mass ; IV., from Hudson, Mass.; V., from North Amherst, Mass.; VI., from Lawrence, Mass.]

	Per Cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	11.47	3.46	4.70	18.10	10.38	16.12
Calcium oxide,	37.51	35.76	2.51	31.75	23.84	30.38
Magnesium oxide,	3.20	4.32	1.22	2.59	3.05	2.64
Ferric oxide,	0.24	0.55	4.23	0.77	5.89	1.32
Potassium oxide,	4.22	4.21	0.92	3.32	2.93	3.94
Phosphoric acid,	1.40	2.01	0.56	1.34	1.14	1.52
Insoluble matter (before calcination),	18.84	17.19	84.51	12.53	35.27	17.52
Insoluble matter (after calcination),	16.11	14.85	80.20	10.53	33.73	13.10

Wood Ashes.

[I., sent on from East Whately, Mass.; II., III., IV. and V., sent on from Concord, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	10.52	3.60	21.40	13.75	15.14
Calcium oxide,	37.07	33.78	29.65	33.39	–
Magnesium oxide,	3.46	6.66	4.16	3.38	–
Ferric oxide,	0.72	1.51	0.78	0.49	–
Potassium oxide,	6.48	9.62	5.22	7.24	5.75
Phosphoric acid,	1.43	4.25	1.54	1.53	1.69
Insoluble matter (before calcination),	9.70	9.98	9.87	10.96	13.44
Insoluble matter (after calcination),	7.06	5.52	7.96	9.19	11.40

All above-stated samples of unleached wood ashes are represented as Canada wood ashes, except No. II., which is a home-made wood ash.

5. *Analyses, etc.* — Continued.

Wood Ashes.

[I., sent on from Concord, Mass.; II , sent on from Beverly, Mass.; III., sent on from Sunderland, Mass.; IV., sent on from North Amherst, Mass.; V., sent on from Sunderland, Mass.]

	PER CENT.				
	I.	II.	III.	IV.	V.
Moisture at 100° C.,	15.50	11.78	15.69	9.52	17.48
Calcium oxide,	30.16	29.12	31.59	25.12	32.23
Magnesium oxide,	3.28	4.53	3.30	4.67	3.07
Ferric oxide,	0.99	1.14	0.40	1.49	0.67
Potassium oxide,	6.76	4.77	6.99	3.83	5.04
Phosphoric acid,	2.13	1.83	1.39	1.40	1.17
Insoluble matter (before calcination),	12.04	15.16	11.10	28.38	11.72
Insoluble matter (after calcination),	11.68	11.48	10.26	22.05	10.74

Wood Ashes.

[I , sent on from Rock Bottom, Mass.; II., sent on from South Framingham, Mass.; III., sent on from Berlin, Mass.; IV., sent on from Amesbury, Mass.; V., sent on from Beverly, Mass.; VI., sent on from Bolton, Mass.]

	PER CENT.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	18.00	20.08	2.10	9.43	10.22	11.50
Calcium oxide,	34.40	32.16	36.00	32.52	38.98	35.66
Magnesium oxide,	2.90	3.28	3.30	2.14	3.39	4.45
Ferric oxide,	–	0.69	–	–	–	–
Potassium oxide,	4.52	4.65	5.27	4.90	6.28	4.57
Phosphoric acid,	1.46	2.70	1.62	1.84	1.42	1.56
Insoluble matter (before calcination),	12.39	9.67	19.47	20.52	9.51	16.58
Insoluble matter (after calcination),	11.44	8.12	17.78	18.30	8.54	14.83

All above-stated samples of unleached wood ashes are represented as Canada wood ashes. Samples I., II., IV. and VI. contain less potash than the average of Canada wood ash usually sold in our markets.

5. *Analyses, etc.* — Continued.

Wood Ashes.

[I., sent on from Framingham, Mass.; II. and III., sent on from South Deerfield, Mass.; IV., sent on from Essex, Mass.; V. and VI., sent on from Sudbury, Mass.]

	Per Cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	19.73	7.26	20.65	0.64	16.64	24.26
Calcium oxide,	31.49	37.07	29.65	40.49	–	–
Magnesium oxide,	2.85	2.90	2.70	3.07	–	–
Ferric oxide,	1.24	1.02	1.89	–	–	–
Potassium oxide,	4.94	4.34	4.62	6.42	4.24	4.71
Phosphoric acid,	1.57	1.48	1.46	1.57	1.34	2.66
Insoluble matter (before calcination),	12.57	14.45	10.10	12.03	18.08	23.92
Insoluble matter (after calcination),	10.29	12.48	8.13	9.10	14.84	19.92

Wood Ashes.

[I., sent on from Amherst, Mass.; II., sent on from Holden, Mass.; III. and IV., sent on from Concord, Mass.; V., sent on from Rock Bottom, Mass.; VI., sent on from Stow, Mass.]

	Per Cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	12.34	19.34	17.98	16.65	11.62	13.27
Calcium oxide,	33.08	30.27	28.86	30.36	35.63	34.74
Magnesium oxide,	2.85	3.98	3.12	3.10	2.97	3.04
Ferric oxide,	0.79	0.86	0.09	1.44	0.86	0.66
Potassium oxide,	5.60	5.11	6.81	6.10	6.40	6.32
Phosphoric acid,	1.93	3.53	1.66	1.54	1.60	1.57
Insoluble matter (before calcination),	15.45	10.86	17.22	13.00	10.93	10.02
Insoluble matter (after calcination),	11.19	9.37	14.66	11.32	9.02	8.44

5. *Analyses, etc.* — Continued.

Cotton-seed-hull Ashes.

[I., sent on from Sunderland, Mass.; II. and III., sent on from North Hadley, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	7.77	6.30	4.58
Calcium oxide,	8.02	–	–
Magnesium oxide,	12.57	–	–
Potassium oxide,	30.00	16.48	9.91
Phosphoric acid,	13.19	6.58	4.41
Insoluble matter (before calcination),	12.52	41.94	57.40
Insoluble matter (after calcination),	9.40	29.65	34.28

Sample II. and in particular Sample III. are of an exceptional inferior quality. Cotton-seed-hull ashes and cotton-seed meal sold for manurial purposes ought to be bought on a guaranteed composition. Both articles are liable to a serious fluctuation in composition. All articles sold for manurial purposes, at ten dollars or more per ton, are subject to our laws for the regulation of the trade in commercial fertilizers.

Cotton-hull Ashes.

[I., sent on from North Hadley, Mass.; II., sent on from Feeding Hills, Mass.; III., sent on from Sunderland, Mass *]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	11.79	6.30	4.41
Calcium oxide,	8.37	13.94	4.91
Magnesium oxide,	10.27	2.85	5.57
Ferric and aluminic oxides,	1.50	2.49	4.35
Potassium oxide,	26.26	26.98	16.63
Phosphoric acid,	12.06	8.40	7.21
Insoluble matter (before calcination),	15.37	13.23	47.47
Insoluble matter (after calcination),	11.94	11.19	40.02

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* Cotton-hull and wood ashes mixed.

5. *Analyses, etc.* — Continued.

Cotton-hull Ashes.

[Three samples, sent on from Hatfield, Mass.]

	PER CENT.		
	I.	II.	III.
Moisture at 100° C,	14.18	13.65	14.22
Calcium oxide,	10.26	15.12	15.25
Magnesium oxide,	10.28	6.37	6.02
Ferric oxide,	1.88	1.51	1.08
Potassium oxide,	20.56	27.06	26.91
Phosphoric acid,	9.13	8.07	13.48
Insoluble matter (before calcination),	12.64	10.14	9.87
Insoluble matter (after calcination),	11.48	8.10	7.24

Cotton-seed Meal for Fertilizer.

[I. and II., sent on from Hatfield, Mass.; III., sent on from Amherst, Mass.]

	PER CENT.		
	I.	II.	III.
Moisture at 100° C.,	7.98	9.84	7.28
Ash,	–	–	7.14
Phosphoric acid,	3.26	3.30	2.20
Potassium oxide,	2.01	2.03	2.06
Nitrogen,	6.21	6.64	6.28
Insoluble matter,	0.07	0.08	0.09

5. *Analyses, etc.* — Continued.

Calcium Sulphate.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	18.02
Calcium oxide,	32.40
Sulphuric acid,	42.08
Insoluble matter,	2.35

Burnt Lime.

[Sent on from Amherst, Mass.]

	Per Cent.
Calcium oxide,	88.64
Insoluble matter,	4.71

Nitrate of Soda.

[I., sent on from South Sudbury, Mass.; II., sent on from North Hadley, Mass.; III., sent on from Amherst, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	1.38	1.78	1.20
Sodium oxide,	–	–	38.90
Nitrogen,	15.56	15.77	15.81

Muriate of Potash.

[I., sent on from Hadley, Mass.; II., sent on from Richmond, Mass.; III., sent on from Amherst, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	1.40	1.30	1.09
Potassium oxide,	49.95	46.64	50.40
Insoluble matter,	–	0.44	–

5. *Analyses, etc.* — Continued.

Sulphate of Potash.

[Sent on from Richmond, Mass.]

	Per Cent.
Moisture at 100° C.,	6.17
Potassium oxide,	24.32
Insoluble matter,	0.56

Florida Phosphate Rock.

[I., sent on from Amherst; II., sent on from Fort Meade, Fla.; III. and IV., sent on from Vicksburg, Miss.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	2.24	13.62	1.59	1.38
Phosphoric acid,	21.67	22.42	23.96	23.71
Calcium oxide,	–	28.06	35.41	33.84
Ferric and aluminic oxides,	5.02	9.46	9.70	4.80
Insoluble matter,	34.67	23.30	4.68	9.52
Carbonic acid,	Trace.	–	–	–

Florida Phosphate Rock.

[I., II., III. and IV., from Oscala, Fla.; V., from Pitman, Fla.; VI., sent on from Boston, Mass.]

	Per Cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	2.03	1.90	6.53	0.99	5.28	0.58
Phosphoric acid,	21.34	24.10	7.68	38.97	18.23	32.18
Calcium oxide,	–	–	–	–	–	29.78
Ferric and aluminic oxides,	2.53	2.42	2.84	1.20	3.11	15.85
Insoluble matter,	24.64	26.44	48.77	2.35	33.89	9.16

5. *Analyses, etc.* — Continued.

Dissolved Bone-black.

[I. and II., sent on from Amherst, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	18.50	15.15
Ash,	55.52	50.40
Total phosphoric acid,	15.35	17.55
Soluble phosphoric acid,	14.87	17.51
Reverted phosphoric acid,	0.29	–
Insoluble phosphoric acid,	0.19	–
Insoluble matter,	2.95	0.12

Superphosphate.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	14.23
Ash,	69.95
Total phosphoric acid,	14.64
Soluble phosphoric acid,	10.34
Reverted phosphoric acid,	2.42
Insoluble phosphoric acid,	1.88
Insoluble matter,	10.81

Fine-ground Bone.

[Sent on from Amherst, Mass.]

Mechanical Analysis.

	Per Cent.
Fine,	48.57
Fine medium,	24.20
Medium,	20.59
Coarse medium,	6.64

Chemical Analysis.

Moisture at 100° C.,	8.40
Ash,	54.81
Total phosphoric acid,	15.16
Soluble phosphoric acid,	2.33
Reverted phosphoric acid,	6.42
Insoluble phosphoric acid,	6.41
Nitrogen,	3.89
Insoluble matter,	0.42

5. *Analyses, etc.* — Continued.

Tankage.

[I., sent on from Worcester, Mass.; II., sent on from Hadley, Mass.; III., sent on from Lexington, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	5.78	6.05	40.92
Ash,	49.57	35.58	28.53
Total phosphoric acid,	18.86	8.65	7.39
Soluble phosphoric acid,	0.54	0.05	Trace.
Reverted phosphoric acid,	9.88	5.39	4.30
Insoluble phosphoric acid,	8.38	3.21	3.09
Nitrogen,	4.16	5.04	4.73
Insoluble matter,	1.48	2.62	0.40

Dry Ground Fish.

[I., sent on from Hadley, Mass.; II., sent on from North Hadley, Mass.; III., sent on from Amherst, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	10.54	9.12	13.66
Ash,	17.45	20.13	19.23
Total phosphoric acid,	6.75	7.04	7.39
Soluble phosphoric acid,	0.75	0.27	–
Reverted phosphoric acid,	3.25	3.10	–
Insoluble phosphoric acid,	2.75	3.67	–
Nitrogen,	7.64	8.47	9.16
Insoluble matter,	1.06	2.85	2.39

5. *Analyses, etc.* — Continued.

Fish Chum.

[Sent on from Beverly, Mass.]

	Per Cent.
Moisture at 100° C.,	6.46
Ash,	25.33
Total phosphoric acid,	9.15
Soluble phosphoric acid,	0.56
Reverted phosphoric acid,	5.99
Insoluble phosphoric acid,	2.60
Nitrogen,	5.50
Insoluble matter,	1.12

Wool Waste from Factories.

[I., shoddy mill waste, sent on from Lawrence, Mass.; II., wool waste, sent on from Spencer, Mass.; III., wool refuse, sent on from Gilbertville, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C,	11.38	43.05	27.05
Ash,	12.23	3.93	38.84
Potassium oxide,	0.14	0.06	0.42
Phosphoric acid,	0.08	0.05	0.07
Nitrogen,	3.44	6.67	1.05
Insoluble matter,	7.52	1.08	34.00

The best use which can be made of this class of refuse materials is to incorporate them into the barn-yard manure; they are essentially a nitrogenous source of plant food. Their commercial manurial value depends on their percentage of nitrogen. From seven to eight cents per pound of the latter is a fair basis of valuation.

Cotton Waste.

[Sent on from Fall River, Mass.]

	Per Cent.
Moisture at 100° C.,	5.63
Ash,	60.68
Potassium oxide,	0.66
Phosphoric acid,	0.26
Nitrogen,	0.96
Insoluble matter,	55.20

5. *Analyses, etc.* — Continued.

Tobacco Leaves.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	11.97
Ash,	20.48
Calcium oxide,	4.83
Magnesium oxide,	1.36
Ferric oxide,	0.22
Potassium oxide,	6.06
Phosphoric acid,	1.15
Nitrogen,	2.95
Insoluble matter,	2.35

The tobacco leaves contain more than twice the amount of mineral constituents found in the tobacco stems. The ash of the latter contains more phosphoric acid and potash than that of the former, while that of the leaves is richer in lime and magnesia than that of the stems.

Saltpetre Waste.

[Sent on from Littleton Common, Mass.]

	Per Cent.
Moisture at 100° C.,	1.23
Potassium oxide,	2.70
Sodium oxide,	47.99
Nitrogen,	0.61

The material contains usually a large amount of common salt, and may be used with good effect upon grass lands.

Waste from Lactate Factory.

[Sent on from Littleton Centre, Mass.]

	Per Cent.
Moisture at 100° C.,	34.11
Ash,	60.24
Calcium oxide,	22.55
Potassium oxide,	Trace.
Phosphoric acid,	0.67
Nitrogen,	0.68
Insoluble matter,	6.92

5. *Analyses, etc.* — Continued.

Muck.

[I., sent on from Brookline, Mass.; II., sent on from Fort Meade, Fla.; III. and IV., sent on from Boston, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	81.03	31.17	70.00	74.87
Organic matter,	10.96	4.18	14.84	14.46
Ash,	8.01	64.65	15.16	10.67
Calcium oxide,	–	–	0.28	0.14
Nitrogen,	0.36	0.06	0.49	0.46
Phosphoric acid,	–	–	0.17	0.073
Insoluble matter,	7.04	59.13	13.47	9.24

Peat.

[Sent on from Marshfield, Mass.]

	Per Cent.
Moisture at 100° C,	35.17
Ash,	21.92
Nitrogen,	1.16

Mud.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	22.45
Organic matter,	10.83
Ash,	66.72
Calcium oxide,	3.64
Potassium oxide,	0.25
Phosphoric acid,	Trace.
Nitrogen,	0.43
Insoluble matter,	29.26

5. *Analyses, etc.* — Continued.

Marl.

[I., sent on from West Springfield, Mass.; II., sent on from Marshfield, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	1.65	3.15
Calcium oxide,	47.61	0.37
Magnesium oxide,	0.58	1.71
Ferric oxide,	Trace.	Trace.
Potassium oxide,	Trace.	0.24
Phosphoric acid,	0.10	1.41
Carbonic acid,	34.03	None.
Insoluble matter,	2.81	79.73

Home-mixed Fertilizers.

[I., sent on from North Hadley, Mass.; II., sent on from Agawam, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	15.86	9.69
Ash,	63.56	39.20
Total phosphoric acid,	12.88	5.36
Soluble phosphoric acid,	8.24	1.69
Reverted phosphoric acid,	2.87	3.06
Insoluble phosphoric acid,	1.77	0.61
Potassium oxide,	5.97	8.28
Nitrogen,	1.53	4.30
Insoluble matter,	1.69	0.87

5. Analyses, etc. — Concluded.

Complete Fertilizers.

[I., sent on from Boston, Mass.; II., home-mixed fertilizer, sent on from Conway, Mass.; III. and IV., sent on from North Hadley, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	6.54	6.67	17.78	14.54
Ash,	46.27	49.21	50.12	48.42
Total phosphoric acid,	11.64	13.82	4.57	7.42
Soluble phosphoric acid,	7.78	6.27	1.77	6.90
Reverted phosphoric acid,	2.81	5.99	0.78	0.33
Insoluble phosphoric acid,	1.05	1.56	2.02	0.19
Potassium oxide,	4.29	4.98	10.72	7.19
Nitrogen,	3.66	3.44	5.14	3.75
Insoluble matter,	1.72	0.64	3.12	0.81

Complete Fertilizers.

[I., II. and III., sent on from South Sudbury, Mass.; IV., sent on from Sixteen Acres, Mass.; V. and VI., sent on from Richmond, Mass.]

	Per Cent.					
	I.	II.	III.	IV.	V.	VI.
Moisture at 100° C.,	18.05	15.92	16.54	12.43	12.14	13.54
Ash,	56.55	55.82	69.10	37.44	48.40	46.96
Total phosphoric acid,	8.47	11.68	10.26	8.05	9.44	10.87
Soluble phosphoric acid,	1.64	6.91	7.16	2.58	3.48	6.12
Reverted phosphoric acid,	3.67	1.19	1.69	3.27	3.24	3.59
Insoluble phosphoric acid,	3.16	3.58	1.36	2.20	2.72	1.16
Potassium oxide,	4.04	2.32	1.98	6.08	7.94	5.20
Nitrogen,	2.13	2.28	1.10	2.58	2.89	2.73
Insoluble matter,	3.58	5.37	6.72	1.10	1.82	0.64

6. *Miscellaneous Analyses.*

Paris Green.

[I. and II., sent on by the Gypsy Moth Commission from Boston, Mass.; III. and IV., sent on from Amherst, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	1.30	1.15	1.41	1.40
Copper oxide,	32.84	30.40	33.20	33.10
Arsenious oxide,	62.55	59.92	61.40	61.15
Insoluble matter,	0.21	0.10	0.09	0.64
Acetic acid,	3.10	8.43	3.90	3.71

Tobacco Liquor.

[Two samples sent on from Hyannis, Mass.]

	Per Cent.	
	I.	II.
Nicotine,	4.55	4.82

Dalmation Insect Powder.

[Sent on from Boston, Mass.]

	Per Cent.
Total ash,	15.52
Ash insoluble in hydrochloric acid,	9.20

No trace of mineral poisons was found. Under the microscope the vegetable matter had the general appearance of genuine pyrethrum powder.

6. *Miscellaneous Analyses* — Continued.

Carnation Pinks (Whole Plant).

[Sent on from Framingham, Mass.]

	Per Cent.
Moisture at 100° C.,	8.08
Ash,	8.80
Calcium oxide,	1.64
Magnesium oxide,	0.35
Ferric and aluminic oxides,	0.03
Sodium oxide,	1.13
Potassium oxide,	3.35
Phosphoric acid,	0.46
Nitrogen,	1.06
Insoluble matter,	0.21

Grapes.

[Sent on from Amherst, Mass.]

	Per Cent.
Moisture at 100° C.,	86.23
Ash,	0.5481
100 parts of ash contain: —	
Calcium oxide,	3.50
Magnesium oxide,	2.531
Ferric oxide,	1.193
Potassium oxide,	49.765
Phosphoric acid,	13.567
Nitrogen (in dry matter),	0.961

*Woods.**

[I, sound wood of plum; II., black knot of plum.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	6.590	7.990
Ash,	2.220	4.220
Calcium oxide,	0.684	0.690
Magnesium oxide,	0.119	0.232
Ferric oxide,	0.012	0.052
Potassium oxide,	0.387	1.438
Phosphoric acid,	0.132	0.475
Nitrogen,	0.570	1.450
Insoluble matter,	0.013	0.009

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* Collected off of the same tree, Amherst, Mass.

6. *Miscellaneous Analyses* — Continued.

Banana Skins.

[Sent on from Boston, Mass.]

	Per Cent.
Moisture at 100° C.,	13.99
Ash,	13.06
Calcium oxide,	1.44
Magnesium oxide,	0.11
Ferric and aluminic oxides,	0.26
Potassium oxide,	5.46
Phosphoric acid,	1.48
Nitrogen,	0.24

Analysis of the Ash.

Calcium oxide,	11.12
Magnesium oxide,	0.84
Ferric and aluminic oxides,	1.99
Potassium oxide,	41.80
Phosphoric acid,	11.33
Insoluble matter,	10.15

Sugar Beets.

[Sent on from Boston, Mass.]

Analysis of Beets.

	Per Cent.
Moisture at 100° C.,	77.35
Sugar by Fehling's test,	13.57
Sugar by polariscope,	13.59

Analysis of Juice.

Degrees Brix, corresponding for temperature,	21.2°
Specific gravity,	1.08869
Total solids,	20.52
Ash,	1.65
Sugar by Fehling's test,	16.02
Coefficient of purity,	78.05

Vinegar.

[I., sent on from Williamsburg, Mass.; II., III., IV., V., sent on from Prescott, Mass.]

	PER CENT.				
	I.	II.	III.	IV.	V.
Specific gravity,	1.02565	1.00998	1.00732	1.01172	1.00448
Acetic acid,	4.80	4.66	4.82	5.27	3.97
Solid residue,	4.51	1.70	1.76	1.55	1.00

6. *Miscellaneous Analyses* — Continued.

Vinegar.

[Sent on from Amherst, Mass.]

	Per Cent.	
	I.	II.
Specific gravity,	1.01086	1.01206
Acetic acid,	5.02	5.15
Solid residue,	1.51	1.48

Vinegar Mash.

[Sent on from Boston, Mass. I., total solid residue on evaporation; II., residue from which liquid or soluble portion had been removed (insoluble residue).]

Average Composition.

	Per Cent.
Moisture at 100° C.,	94.49
Dry matter,	5.51
	100.00

Analysis of Dry Matter.

	Per Cent.	
	I.	II.
Crude ash,	3.03	2.92
" cellulose,	8.55	9.42
" fat,	8.45	7.77
" protein,	16.50	13.91
Non-nitrogenous extract matter,	63.47	65.98
	100.00	100.00
Nitrogen in dry matter,	2.64	2.22
Potassium oxide in dry matter,	0.84	0.34
Phosphoric acid in dry matter,	1.27	0.93
Acidity (calculated as acetic acid),	–	0.33

6. *Miscellaneous Analyses* — Continued.

Baking Powder.

[Sent on from Amherst, Mass.]

	Per Cent.
Total carbonic acid,	8.28
Phosphoric acid,	0.10
Sulphuric acid,	11.17
Aluminic oxide,	2.00

Analyses of Milk sent on for Examination.

[Per Cent.]

Number of Sample.	Solids.	Fat.	Solids not Fat.	Locality.	Remarks.
1,	11.95	3.18	8.77	Lee.	Skim-milk.
2,	11.96	3.51	8.45		
3,	9.42	0.63	8.79		
4,	13.21	3.90	9.31	Millbury.	
5,	12.74	4.20	8.54	Lee.	
6,	9.24	0.28	8.96	Belchertown.	Buttermilk.
7,	11.18	2.92	8.26	Lawrence.	
8,	9.31	0.20	9.11	Tully.	Skim-milk.
9,	12.72	4.23	8.49	Amherst.	
10,	11.94	3.16	8.78		
11,	13.28	4.17	9.11		
12,	14.19	5.10	9.09	Warren.	
13,	12.84	3.85	8.99		
14,	14.10	4.54	9.56		
15,	13.28	3.79	9.49		
16,	13.18	3.87	9.31		
17,	13.98	4.73	9.25		
18,	15.76	5.95	9.81	Worcester.	
19,	14.47	4.30	10.17		
20,	15.93	6.40	9.53		
21,	16.68	6.75	9.93		
22,	16.64	6.92	9.72		
23,	15.39	5.85	9.54		
24,	13.64	4.43	9.21	Warren.	
25,	12.38	3.27	9.11		
26,	12.67	3.79	8.88		
27,	13.85	4.38	9.47		
28,	12.99	3.94	9.05		
29,	12.46	3.89	8.57		
30,	14.14	4.75	9.39	Warren.	
31,	13.17	3.65	9.52		
32,	13.14	4.33	8.81		
33,	12.84	4.61	8.23		
34,	11.95	3.62	8.33		
35,	13.10	4.22	8.88	Barre Plains.	
36,	10.58	2.79	7.79		
37,	13.52	4.73	8.79		
38,	12.21	3.85	8.36		

6. *Miscellaneous Analyses* — Concluded.

Analyses of Milk, etc. — Concluded.

Number of Sample.	Solids.	Fat.	Solids not Fat.	Locality.	Remarks.
39, . .	12.19	3.63	8.56	Belchertown.	
40, . .	13.65	4.65	9.00	Barre Plains.	
41, . .	13.35	4.42	8.93		
42, . .	14.24	4.69	9.55		
43, . .	13.08	4.17	8.91		
44, . .	12.38	3.19	9.19		
45, . .	16.87	6.37	10.50		
46, . .	15.16	5.81	9.35		
47, . .	16.46	6.76	9.70	New Braintree.	
48, . .	16.00	6.51	9.49		
49, . .	15.41	6.13	8.28		
50, . .	16.61	7.33	9.28		
51, . .	15.31	5.58	9.73		
52, . .	16.05	6.40	9.65		
53, . .	13.04	4.63	8.41	Barre Plains.	
54, . .	12.72	3.83	8.89		
55, . .	11.10	3.27	7.83		
56, . .	11.28	3.59	7.69		
57, . .	11.68	4.78	6.90		
58, . .	11.15	3.91	7.24		
59, . .	13.32	4.62	8.70		
60, . .	12.29	4.56	7.73	North Adams.	
61, . .	15.23	6.92	8.31	North Adams.	
62, . .	13.25	4.25	9.00	Northborough.	

II. ANALYSES OF WATER SENT ON FOR EXAMINATION.

[Parts per Million.]

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
1	.084	.116	24.00	86.00	56.00	2.60	None.	Billerica.
2	.096	.144	16.00	80.00	50.00	–	–	Upton.
3	.120	.128	10.00	94.00	54.00	–	–	Upton.
4	.080	.136	5.00	12.00	6.00	–	–	Upton.
5	.112	.296	36.00	308.00	152.00	–	–	Upton.
6	.072	.104	4.00	86.00	60.00	2.86	None.	Amherst.
7	.052	.828	Trace.	36.00	20.00	1.27	None.	Sunderland.
8	.026	.070	8.00	98.00	44.00	1.27	–	Methuen.
9	.060	.108	Trace.	50.00	20.00	.95	None.	Cooleyville.
10	.088	.168	144.00	606.00	214.00	8.86	None.	North Amherst.
11	.020	.060	16.00	96.00	36.00	3.90	None.	Amherst.
12	.088	.092	34.00	150.00	96.00	2.60	None.	Plainville.
13	.640	.328	20.00	112.00	8.00	3.90	None.	Amherst.
14	–	–	56.00	–	–	–	–	Amherst.
15	–	–	24.00	–	–	–	–	Amherst.
16	.052	.136	Trace.	82.00	72.00	.16	None.	Westford.
17	.060	.140	Trace.	100.00	36.00	1.95	None.	Amherst.
18	.092	.204	Trace.	74.00	56.00	2.60	–	Amherst.
19	.140	1.480	48.00	322.00	48.00	5.29	None.	Weston.
20	.172	.176	12.00	146.00	26.00	2.60	None.	Amherst.
21	.050	.080	Trace.	56.00	26.00	1.27	Present.	Cooleyville.
22	.068	.072	Trace.	58.00	30.00	1.27	None.	Leverett.
23	.144	.120	Trace.	44.00	24.00	.32	None.	Westford.
24	.080	.148	28.00	314.00	154.00	6.00	None.	Natick.
25	.060	.052	20.00	154.00	86.00	4.57	None.	Amherst.
26	.108	.156	20.00	254.00	90.00	5.00	–	Agawam.
27	None.	.030	14.00	120.00	50.00	3.25	None.	North Amherst.
28	.040	.140	14.00	84.00	14.00	3.90	None.	Amherst.
29	.120	.080	8.00	80.00	50.00	1.27	None.	North Amherst.
30	–	–	–	–	–	–	Present.	North Amherst.
31	.200	.172	10.00	–	–	–	–	North Amherst.
32	.120	.072	Trace.	80.00	46.00	3.25	None.	Amherst.
33	1.680	.096	60.00	364.00	74.00	6.71	None.	Sunderland.

II. ANALYSES OF WATER, ETC. — *Concluded.*

NUMBER.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at Red Heat.	Hardness (Clark's Degree).	Lead.	Locality.
34	.112	.140	12.00	90.00	80.00	5.25	None.	Amherst.
35	.112	.180	46.00	210.00	80.00	3.25	-	North Hadley.
36	.076	.118	Trace.	40.00	10.00	1.27	Present.	North Amherst.
37	.296	.240	20.00	314.00	74.00	-	-	Amherst.
38	.016	.264	Trace.	88.00	10.00	1.95	Present.	Graniteville.
39	.014	.140	12.00	58.00	16.00	2.60	None.	Athol.
40	.020	.088	8.00	20.00	6.00	1.95	-	North Amherst.
41	.100	.070	2.00	90.00	20.00	2.60	-	North Amherst.
42	.010	.066	4.00	32.00	6.00	.48	None.	Cooleyville.
43	.016	.132	8.00	130.00	70.00	2.60	None.	Sunderland.
44	.074	.098	6.00	50.00	6.00	1.95	-	Amherst.
45	.020	.066	170.00	608.00	378.00	12.56	None.	Amherst.
46	.012	.066	2.09	258.00	176.00	14.84	None.	Richmond.
47	.040	.084	9.00	174.00	84.00	6.00	None.	North Hadley.
48	None.	.106	4.00	62.00	16.00	.48	None.	Amherst.
49	.108	.180	4.00	130.00	70.00	1.95	None.	West Brookfield.
50	.140	.120	27.00	216.00	116.00	6.00	None.	Foxborough.
51	.040	.230	16.00	170.00	74.00	9.57	None.	Amherst.
52	.010	.066	Trace.	90.00	54.00	2.99	None.	Amherst.
53	None.	.084	20.00	252.00	72.00	4.57	None.	Amherst.
54	.112	.140	7.00	136.00	56.00	2.60	-	Blackstone.
55	.120	.120	11.00	170.00	70.00	5.29	-	Amherst.
56	.128	.160	4.00	126.00	46.00	3.25	-	Amherst.
57	.038	.150	4.00	84.00	24.00	2.60	-	Hadley.
58	.024	.092	8.00	94.00	54.00	2.60	None.	North Hadley.
59	None.	.200	2.00	46.00	20.00	.48	-	Hawley.
60	.096	.128	6.00	130.00	30.00	1.95	-	Amherst.
61	None.	.170	Trace.	160.00	90.00	1.27	-	Moore's Corner.
62	.018	.098	13.00	180.00	90.00	6.71	None.	Springfield.
63	.014	.070	3.00	34.00	20.00	1.95	None.	Rutland.
64	.060	.148	6.00	114.00	44.00	1.95	-	Westhampton.
65	.004	.100	4.00	116.00	40.00	.48	None.	Belchertown.
66	.990	.440	15.00	164.00	54.00	2.47	None.	Weston.
67	.080	.270	9.00	105.00	45.00	2.73	None.	Weston.
68	.260	.964	34.00	237.00	130.00	-	-	Grafton.

The analyses have been made according to Wanclyn's process, familiar to chemists, and are directed towards the indication of the presence of chlorine, free and albuminoid ammonia, and the poisonous metals, lead in particular. (For a more detailed description of this method, see "Water Analyses," by J. A. Wanklyn and E. T. Chapman.)

Mr. Wanklyn's interpretation of the results of his mode of investigation is as follows: —

1. Chlorine alone does not necessarily indicate the presence of filthy water.
2. Free and albuminoid ammonia in water, without chlorine, indicates a vegetable source of contamination.
3. More than five grains per gallon* of chlorine (= 71.4 parts per million), accompanied by more than .08 parts per million of free ammonia and more than .10 parts per million of albuminoid ammonia, is a clear indication that the water is contaminated with sewage, decaying animal matter, urine, etc., and should be condemned.
4. Eight-hundredths parts per million of free ammonia and one-tenth part per million of albuminoid ammonia render a water very suspicious, even without much chlorine.
5. Albuminoid ammonia, over .15 parts per million, ought to absolutely condemn a water which contains it.
6. The total solids found in the water should not exceed forty grains per gallon (571.4 parts per million).

An examination of the previously stated analyses indicates that Nos. 1, 2, 3, 4, 5, 10, 13, 18, 19, 20, 23, 24, 26, 29, 31, 32, 33, 34, 35, 37, 49, 50, 54, 55, 56, 60, 66, 67 and 68 ought to be condemned as unfit for family use; while Nos. 6, 9, 12, 16, 17, 22, 36, 41, 44 and 64 must be considered suspicious. From this record it will be seen that over two-fifths of the entire number of well waters tried proved unfit for drinking. Heating waters to the boiling point removes not unfrequently immediate danger.

Parties sending on water for analysis ought to be very careful to use clean vessels, clean stoppers, etc. The samples should be sent on without delay after collecting. One gallon is desirable for the analysis.

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* One gallon equals 70,000 grains.

III. COMPILATION OF ANALYSES MADE AT AMHERST, MASS., OF AGRICULTURAL CHEMICALS AND REFUSE MATERIALS USED FOR FERTILIZING PURPOSES.

PREPARED BY R. B. MOORE.

[As the basis of valuation changes from year to year, no valuation is stated.]

1868-1892.

This compilation does not include the analyses made of licensed fertilizers. They are to be found in the reports of the State Inspector of Fertilizers from 1873 to 1891, contained in the reports of the Secretary of the Massachusetts State Board of Agriculture for those years.

C. A. G.

	Analyses.	Moisture.	Ash.	NITROGEN.			POTASH.			TOTAL PHOSPHORIC ACID.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
I. Chemicals, Refuse, Salts, Ashes, etc.																							
Muriate of potash,	57	2.00	-	-	-	-	58.98	45.94	**51.48**	-	-	-	-	-	-	6.69	-	.55	-	-	-	48.80	.70
Sulphate of potash,	20	2.54	-	-	-	-	51.28	21.36	**33.40**	-	-	-	-	-	-	4.46	-	1.50	-	45.72	-	-	.75
Sulphate of potash and magnesia,	15	4.75	-	-	-	-	29.48	16.96	**23.50**	-	-	-	-	-	-	6.25	2.57	-	-	44.25	-	2.60	1.41
Kainite,	4	3.20	-	-	-	-	16.48	12.51	**13.54**	-	-	-	-	-	-	18.97	1.15	9.80	-	20.25	-	33.25	2.13
Carnallite,	1	-	-	-	-	-	-	-	**13.68**	-	-	-	-	-	-	7.66	-	13.19	-	.56	-	41.56	-
Krugite,	1	4.82	-	-	-	-	-	-	**8.42**	-	-	-	-	-	-	5.27	12.45	8.79	-	31.94	-	6.63	14.96
Sulphate of magnesia (Kieserite),	9	22.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.82	17.30	-	36.10	-	-	5.73
Nitrate of potash,	2	1.93	-	14.58	11.60	**13.09**	45.62	44.76	**45.19**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate of soda,	22	1.40	-	16.01	14.44	**15.70**	-	-	-	-	-	-	-	-	-	35.50	-	-	-	-	-	.50	.50
Sulphate of ammonia,	24	1.00	-	21.68	19.70	**20.50**	-	-	-	-	-	-	-	-	-	-	-	-	-	60.00	-	-	-
Saltpetre waste,	11	2.60	-	3.30	.52	**2.28**	30.94	1.55	**14.34**	-	-	-	-	-	-	36.50	.75	.19	-	1.85	-	48.30	-
Nitre salt-cake,	2	6.03	-	-	-	**2.29**	-	-	**.87**	-	-	-	-	-	-	29.56	-	-	-	47.77	-	-	3 92
Wood ashes,	189	12.50	-	-	-	-	10.80	2.32	**5.25**	5.58	.51	**1.70**	-	-	-	-	34.00	3.40	.90	-	-	-	12.50
Cotton-seed-hull ashes,	30	7.80	-	-	-	-	42.12	9.91	**22.50**	13.67	2.89	**8.50**	-	-	-	-	9.60	10.75	1.50	-	-	-	11.50
Ashes of spent tan-bark,	3	3.61	-	-	-	-	2.87	1.14	**2.04**	2.77	.13	**1.61**	-	-	-	-	33.46	3.55	-	-	-	-	24.33

Railroad-tie ashes,	1	4.70	-	-	-	-	-	-	.92	-	-	.56	-	-	-	-	2.51	-	-	-	-	-	80.20
Peat ashes,	1	4.67	-	-	-	-	-	-	.46	-	-	.11	-	-	-	-	2.28	1.63	6.13	-	-	-	45.17
Logwood ashes,	1	1.50	-	-	-	-	-	-	.08	-	-	2.30	-	-	-	-	3.90	-	-	-	-	-	9.70
Hard-pine wood ashes,	1	.75	-	-	-	-	-	-	10.16	-	-	2.24	-	-	-	-	24.95	-	-	-	-	-	29.90
Mill ashes,	1	.53	-	-	-	-	-	-	1.60	-	-	.46	-	-	-	-	34.93	1.35	-	-	-	-	36.36
Ashes from blue works	1	12.14	63.78	-	-	-	-	-	9.02	-	-	-	-	-	-	-	-	-	-	-	-	-	12.30
Sea-weed ashes,	1	1.47	-	-	-	-	-	-	.92	-	-	.30	-	-	-	8.76	6.06	4.37	-	2.98	-	6.60	63.65
Nova Scotia plaster,	10	6.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33.85	.75	-	45.75	-	-	2.50
Onondaga plaster,	4	13.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30.00	4.66	-	32.50	8.20	-	9.83
Gas-house lime,	3	22.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43.66	8.30	-	20.73	-	-	6.05
Lime waste from sugar factory,	1	36.30	-	-	-	-	-	-	.22	-	-	2.25	-	-	-	-	27.51	-	-	-	-	-	.32
Lime-kiln ashes,	7	15.45	-	-	-	-	1.70	.02	.86	3.16	.36	1.18	-	-	-	-	44.80	2.60	-	-	17.75	-	8.25
Marls (Massachusetts),	7	13.70	-	-	-	-	-	-	.24	2.72	.06	1.05	-	-	-	-	40.50	.64	.69	-	28.57	-	3.44
Marls (Virginia),	2	15.98	-	-	-	-	.61	.37	.49	.09	.08	.09	-	-	-	-	7.25	.21	-	.66	7.25	-	64.23
Marl (North Carolina),	1	1.50	-	-	-	-	-	-	.04	-	-	.56	-	-	-	-	21.95	.61	-	-	-	-	50.18
II. Guanos, Phosphates, etc.																							
Peruvian guano,	26	14.81	37.61	13.50	4.44	7.85	4.08	1.14	2.61	20.60	5.96	15.26	4.57	3.79	6.90	-	-	-	-	-	-	-	6.60
Bat guano from Texas,	9	40.09	18.24	10.51	2.58	6.47	-	-	1.31	6.53	1.00	3.76	-	-	-	-	-	-	-	-	-	-	2.00
Cuba guano,	5	24.27	-	2.74	.63	1.67	-	-	-	16.16	11.54	13.35	-	-	-	-	-	-	-	-	-	-	3.17
Caribbean guano (orchilla),	12	7.31	-	-	-	-	-	-	-	35.43	18.11	26.77	-	-	-	-	39.95	3.29	-	2.68	-	-	1.27
Mona Island guano,	1	13.32	-	-	-	.76	-	-	-	-	-	21.88	-	7.55	14.33	-	37.49	-	-	-	-	-	2.45

	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
II. Guanos, Phosphates, etc.—Concluded.																							
South Carolina rock phosphate,	5	1.50	-	-	-	-	-	-	-	30.51	25.81	**28.03**	.27	.07	27.69	-	41.87	3.03	4.80	-	-	-	9.04
Florida rock phosphate,	22	2.25	-	-	-	-	-	-	-	38.97	6.95	**24.50**	-	-	-	-	28.50	-	7.25	-	-	-	28.75
Navassa phosphate,	2	7.60	-	-	-	-	-	-	-	34.45	34.09	**34.27**	-	-	-	-	37.45	-	10.27	-	-	-	2.70
Brockville phosphate,	1	2.50	-	-	-	-	-	-	-	-	-	**35.21**	-	-	-	-	-	-	-	-	-	-	6.46
Phosphatic slag,	4	1.45	-	-	-	-	-	-	-	30.51	18.91	**23.49**	-	3.06	21.65	-	48.66	3.42	10.12	-	-	-	9.40
Dissolved bone-black,	2	7.50	47.50	-	-	-	-	-	-	17.54	15.35	**16.45**	15.60	.60	.19	-	-	-	-	-	-	-	1.50
Bone-black,	5	4.60	-	-	-	-	-	-	-	30.54	16.56	**28.28**	-	-	-	-	-	-	-	-	-	-	3.64
South American bone-ash,	1	7.00	-	-	-	-	-	-	-	-	-	**35.89**	-	-	-	-	44.89	-	-	-	-	-	4.50
Acid phosphate,	1	14.23	69.95	-	-	-	-	-	-	-	-	**14.64**	10.34	2.42	1.88	-	-	-	-	-	-	-	10.81
III. Refuse Substances.																							
Dried blood,	14	12.50	6.37	13.55	8.10	**10.52**	-	-	-	6.23	1.53	**1.91**	-	-	-	-	-	-	-	-	-	-	-
Ammonite,	1	5.88	-	-	-	**11.33**	-	-	-	-	-	**3.43**	-	-	-	-	-	-	-	-	-	-	1.38
Oleomargarine refuse,	1	8.54	14.42	-	-	**12.12**	-	-	-	-	-	**.88**	-	-	-	-	-	-	-	-	-	-	.96
Felt refuse,	1	29.24	33.53	-	-	**5.26**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sponge refuse,	1	7.25	-	-	-	**2.43**	-	-	-	-	-	**3.19**	-	-	-	-	3.94	1.27	-	-	-	-	39.05

Horn and hoof waste,	3	10.17	7.63	15.49	11.84	**13.25**	-	-	-	2.30	1.36	**1.83**	-	-	-	-	-	-	-	-	-	-	.24
Raw wool,	1	6.95	7.54	-	-	**12.88**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.63
Wool waste,	7	15.80	24.10	10.20	1.05	**5.70**	3.08	.06	**1.20**	.67	.05	**.35**	-	-	-	-	.11	.06	.80	-	-	-	8.20
Wool washings (water),	1	-	-	-	-	-	-	-	**3.92**	-	-	-	-	-	-	.49	.28	-	-	-	-	-	-
Wool washings (acid),	1	-	-	-	-	-	-	-	**4.20**	-	-	-	-	-	-	.40	.61	.20	-	-	-	-	-
Wool washings (alkaline),	1	92.03	3.28	-	-	**.09**	-	-	**1.09**	-	-	-	-	-	-	.92	.04	-	-	-	-	-	.22
Meat mass,	5	12.09	13.60	11.50	9.69	**10.44**	-	-	-	3.58	.56	**2.07**	-	-	-	-	-	-	-	-	-	-	.58
Bone soup,	1	82.92	7.07	-	-	**1.14**	-	-	-	-	-	**1.26**	-	-	-	-	-	-	-	-	-	-	-
Dried soup from meat and bone,	1	14.80	8.40	-	-	**9.97**	-	-	-	-	-	**.53**	-	-	-	-	-	-	-	-	-	-	.64
Dried soup from rendering cattle feet,	1	10.80	7.50	-	-	**14.47**	-	-	-	-	-	**.46**	-	-	-	-	-	-	-	-	-	-	.26
Dried soup from horse rendering,	1	92.14	-	-	-	**1.12**	-	-	-	-	-	**.14**	-	-	-	-	-	-	-	-	-	-	-
Soap-grease refuse,	2	29.25	51.39	4.20	2.21	**3.21**	-	-	-	15.37	11.04	**13.21**	-	-	-	-	-	-	-	-	-	-	1.29
Bones,	134	7.50	55.90	4.70	1.62	**4.05**	-	-	-	32.52	15.16	**23.25**	.40	7.60	15.75	-	-	-	-	-	-	-	1.10
Tankage,	16	12.50	30.40	8.07	4.16	**6.65**	-	-	-	18.86	7.39	**11.25**	.30	5.10	5.85	-	-	-	-	-	-	-	1.35
Fish with less than twenty per cent. water,	59	12.75	21.50	11.40	6.81	**7.25**	-	-	-	11.26	5.50	**8.25**	.55	2.60	5.10	-	-	-	-	-	-	-	2.20
Fish with between twenty and forty per cent. water,	9	29.34	19.14	7.41	4.22	**5.81**	-	-	-	8.32	4.68	**7.25**	.82	2.87	3.56	-	-	-	-	-	-	-	1.85
Fish with more than forty per cent. water,	10	45.46	15.50	7.60	2.43	**4.97**	-	-	-	8.56	2.94	**5.08**	1.17	1.33	2.58	-	-	-	-	-	-	-	1.35
Whale meat, raw,	1	44.50	1.04	-	-	**4.86**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lobster shells,	1	7.27	-	-	-	**4.50**	-	-	-	-	-	**3.52**	-	-	-	-	22.24	1.30	-	-	-	-	.27
Castor-bean pomace,	4	9.98	5.70	5.72	5.33	**5.56**	1.70	.64	**1.12**	2.22	1.57	**2.16**	-	-	-	-	.87	.29	-	-	-	-	1.75
Cotton-seed meal,	13	7.75	5.90	7.26	4.02	**6.55**	2.09	.89	**1.70**	3.36	1.26	**2.10**	-	-	-	-	.39	.99	-	-	-	-	.40
Rotten brewer's grain,	1	78.77	-	-	-	**.72**	-	-	**.04**	-	-	**.43**	-	-	-	-	.26	.15	-	-	-	-	.59

	Analyses.	Moisture.	Ash.	Nitrogen.			Potash.			Total Phosphoric Acid.			Soluble Phosphoric Acid.	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	Soda.	Lime.	Magnesia.	Ferric and Aluminic Oxides.	Sulphuric Acid.	Carbonic Acid.	Chlorine.	Insoluble Matter.
				Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.											
III. Refuse Substances—Concluded.																							
Tobacco stems,	6	10.61	14.07	2.91	.90	2.29	8.82	3.76	6.44	2.09	.44	.60	-	-	-	.34	3.89	1.23	-	-	-	-	.82
Cotton waste, wet,	1	34.69	-	-	-	1.30	-	-	.80	-	-	1.54	-	-	-	-	2.45	1.13	-	-	-	-	41.33
Cotton waste, dry,	3	6.44	60.60	2.09	.96	1.50	1.62	.66	1.10	.84	.26	.52	-	-	-	-	-	-	-	-	-	-	45.00
Cotton dust,	1	34.46	50.93	-	-	.50	-	-	.19	-	-	.21	-	-	-	-	.90	.90	-	-	-	-	47.46
Glucose refuse,	1	8.10	-	-	-	2.62	-	-	.15	-	-	.29	-	-	-	-	.18	.02	-	-	-	-	.07
Waste from lactate factory,	1	34.11	-	-	-	.68	-	-	-	-	-	.67	-	-	-	-	22.59	-	-	-	-	-	6.92
Hop refuse,	1	8.98	-	-	-	.98	-	-	.11	-	-	.20	-	-	-	-	.27	.10	-	-	-	-	.63
Banana skins,	1	13.99	-	-	-	.24	-	-	5.46	-	-	1.80	-	-	-	-	-	-	-	-	-	-	-
Sumac waste,	1	63.06	6.80	-	-	1.19	-	-	3.25	-	-	-	-	-	-	-	1.14	3.25	-	-	-	-	2.25
Eel-grass,	2	35.39	15.60	.96	.70	.83	1.61	.21	.91	.41	.22	.32	-	-	-	1.63	2.13	.11	-	-	-	-	1.06
Rockweed, green,	1	68.50	23.70	-	-	.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rockweed, dry,	1	10.68	35.75	-	-	1.45	-	-	4.89	-	-	2.75	-	-	-	7.90	7.66	.21	-	-	-	-	10.40
Jute waste,	1	13.10	-	-	-	1.50	-	-	.08	-	-	.72	-	-	-	-	-	-	-	-	-	-	-
Starch waste from rubber factory,	1	10.01	.23	-	-	.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sludge from sewage precipitating tanks,	1	88.49	9.50	-	-	.05	-	-	.05	-	-	.10	-	-	-	-	1.58	.39	6.22	-	-	-	.93
Wet kelp,	1	88.04	2.26	-	-	.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Blue-green algæ (*Lyngbia majuscula*), dry,	1	16.26	-	-	-	4.25	-	-	.79	-	-	.19	-	-	-	3.53	2.06	1.18	-	-	-	-	5.53
Mussel mud, wet,	1	60.01	27.29	-	-	.21	-	-	6.17	-	-	.10	-	-	-	.70	.93	.14	3.48	-	-	-	-
Mussel mud, dry,	1	2.24	72.02	-	-	.72	-	-	-	-	-	.35	-	-	-	-	23.39	-	8.26	-	-	-	37.60
Salt mud,	2	53.37	41.19	.40	.39	.40	.33	.32	.33	-	-	-	-	-	-	.94	.91	.37	4.13	-	-	-	34.88
Fresh-water mud,	1	40.37	-	-	-	1.37	-	-	.22	-	-	.26	-	-	-	-	1.27	.29	1.80	-	-	-	18.26
Muck,	14	57.50	13.75	2.54	.26	1.05	-	-	-	.17	.08	.13	-	-	-	-	-	-	-	-	-	-	11.35
Peat,	10	61.50	8.20	1.40	.41	.85	-	-	.18	-	-	.08	-	-	-	-	.52	.72	2.14	-	-	-	2.20
Turf,	2	19.29	6.36	1.97	1.91	1.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soot,	1	5.54	77.10	-	-	-	-	-	1.83	-	-	-	-	-	-	-	-	-	-	-	-	-	35.34
IV. Animal Excrement, etc.																							
Barn-yard manure,	24	68.87	8.36	.67	.26	.49	.80	.13	.43	.75	.13	.32	-	-	-	-	.30	.19	-	-	-	-	5.40
Poudrette, dry,	1	5.25	35.45	-	-	3.58	-	-	.49	-	-	5.74	-	-	-	-	-	-	-	-	-	-	4.65
Hen manure, fresh,	2	52.35	24.75	1.20	.79	.99	.32	.18	.25	1.00	.47	.74	-	-	-	-	1.19	.89	-	1.24	-	-	23.50
Hen manure, dry,	1	8.35	-	-	-	2.13	-	-	9.94	-	-	2.02	-	-	-	-	2.22	.62	-	-	-	-	34.64

IV. COMPILATION OF ANALYSES OF FODDER ARTICLES, FRUITS, SUGAR-PRODUCING PLANTS, DAIRY PRODUCTS, ETC.,

MADE AT

AMHERST, MASS.

1868-1892.

PREPARED BY R. B. MOORE.

A. ANALYSES OF FODDER ARTICLES.
B. ANALYSES OF FODDER ARTICLES WITH REFERENCE TO FERTILIZING INGREDIENTS.
C. ANALYSES OF FRUIT.
D. ANALYSES OF SUGAR-PRODUCING PLANTS.
E. DAIRY PRODUCTS.
F. INSECTICIDES.

A. *Analyses of Fodder Articles.*

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain —													
					PROTEIN.			FAT.			NITROGEN-FREE EXTRACT.			FIBRE.			Ash.	Nutritive Ratio (Average).
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
I. Green Fodders.																		
Fodder corn,	24	30.53	10.33	19.50	17.19	7.62	10.22	6.10	1.42	2.41	63.13	42.02	55.59	31.53	19.26	25.90	5.88	1:8.10
Fodder corn ensilage,	30	37.43	13.12	22.25	12.58	5.98	8.12	6.49	1.82	3.83	65.69	42.99	55.26	38.92	17.67	27.44	5.35	1:10.22
Corn and soja bean ensilage,	1	–	–	28.97	–	–	15.27	–	–	5.35	–	–	40.50	–	–	37.84	11.04	1:5.32
Sorghum,	6	23.18	12.38	17.41	11.84	7.46	8.74	2.00	1.21	1.55	64.93	47.65	56.15	29.27	22.00	26.73	6.83	1:11.85
Common millet,	9	49.29	21.32	35.42	12.16	5.43	7.50	3.99	2.09	2.74	58.61	46.39	53.89	33.98	24.88	30.99	4.84	–
Japanese millet (white head),	3	26.24	20.95	24.76	10.98	7.26	8.72	2.64	1.94	2.33	50.87	46.71	49.60	38.90	30.12	34.47	4.88	–
Japanese millet (red head),	6	33.83	22.66	27.33	7.99	4.92	6.90	2.45	1.58	2.01	60.83	50.11	52.91	35.29	25.21	32.10	6.08	–
White kibi,	2	24.26	22.85	23.56	15.14	10.79	12.97	1.61	1.50	1.56	53.66	52.30	52.91	31.70	23.03	27.37	5.19	–
Mochi millet,	3	42.29	30.07	37.42	11.90	6.11	9.94	1.94	1.74	1.81	67.08	49.06	55.69	29.80	20.01	25.56	7.00	–
Mix,	3	31.36	18.17	24.45	16.70	9.81	13.53	2.48	1.35	1.86	52.30	47.75	51.27	27.44	26.82	27.06	6.28	–
Green oats,	5	28.82	15.51	20.03	20.47	7.05	13.85	3.32	2.02	2.68	50.69	40.81	45.90	33.12	25.20	29.70	7.87	1:9.97
Timothy (*Phleum pratense* L.),	2	35.00	34.26	34.63	8.83	8.20	8.52	2.07	1.95	2.01	51.33	51.23	51.27	33.23	32.50	32.87	5.33	1:12.26
Hungarian grass (*Setaria Italica* Beauv.),	1	–	–	25.93	–	–	9.38	–	–	1.01	–	–	57.80	–	–	24.66	7.15	1:6.86
Vetch and oats (one part vetch and nine parts oats),	3	24.04	13.89	18.97	10.76	8.83	10.06	2.74	2.29	2.53	49.85	40.10	44.75	35.81	30.77	33.59	9.07	1:7.06
Horse bean, whole plant (*Vicia faba* L.),	1	–	–	15.17	–	–	16.68	–	–	2.31	–	–	47.09	–	–	28.17	5.75	1:2.71
Soja bean (whole plant, *Soja hispida* Mönch),	10	36.36	18.54	23.58	22.19	13.71	16.45	8.98	2.71	4.84	47.89	40.80	44.50	31.89	21.67	26.47	7.74	1:4.20

Cow-pea vines (*Dolichos sineusis* L.),	3	21.19	18.15	19.63	17.93	11.24	14.59	2.99	1.81	2.48	60.62	46.13	52.42	25.88	21.87	23.59	6.92	1:5.82
Serradella (*Ornithopus sativus* Brot.),	2	19.42	15.40	17.41	17.75	12.17	14.96	2.65	2.09	2.37	41.54	35.45	38.49	38.76	26.21	32.49	11.69	1:4.67
White lupine (*Lupinus albus* L.),	1	–	–	14.65	–	–	18.71	–	–	2.41	–	–	42.67	–	–	31.18	5.03	–
Spanish moss (*Tillandsia usneoides* L.),	1	–	–	39.20	–	–	4.45	–	–	2.54	–	–	57.73	–	–	32.61	2.67	–
II. Hay and Dry Coarse Fodders.																		
English hay (mixed hays),	10	91.94	86.96	89.73	11.93	8.47	9.60	2.77	1.56	2.30	54.72	47.11	50.03	35.55	29.21	31.90	6.17	1:11.83
Rowen of mixed hays,	14	91.16	75.55	81.93	14.70	11.63	12.75	5.03	2.60	3.56	53.52	41.92	50.00	31.50	24.25	26.39	7.30	1:6.83
Timothy hay,	6	92.76	81.26	89.39	9.37	7.24	8.66	2.65	1.95	2.22	54.43	50.01	51.55	36.59	29.21	32.90	4.88	1:11.94
Red-top hay (*Agrostis vulgaris* With.),	4	93.19	91.76	92.30	8.40	6.41	7.88	1.69	1.50	1.60	54.74	50.32	52.63	34.11	31.12	32.92	4.97	1:12.06
Kentucky blue-grass (*Poa pratensis* L.),	2	96.10	93.22	94.66	8.78	8.65	8.72	2.08	2.03	2.06	49.61	44.11	46.29	36.84	32.21	34.58	8.35	1:10.38
Orchard grass (*Dactylis glomerata* L.),	4	91.62	90.86	91.17	11.29	7.57	8.99	3.56	2.40	2.91	47.34	43.50	46.15	35.79	34.12	34.89	7.05	1:10.47
Meadow fescue (*Festuca pratensis* Huds.),	5	94.70	87.84	91.09	7.85	5.89	6.76	2.17	1.65	1.87	49.18	42.03	46.31	39.90	34.61	36.93	8.13	1:13.69
Perennial rye-grass (*Lolium perenne* L.),	4	93.64	90.50	92.60	16.56	6.59	11.71	3.15	1.59	2.37	55.77	38.82	48.14	30.86	26.79	29.64	8.14	1 :7.40
Italian rye-grass (*Lolium Italicum* A. Br.),	4	92.62	90.70	91.54	9.75	6.20	8.15	2.07	1.39	1.85	52.80	43.09	49.14	36.90	31.27	33.34	7.52	1:10.90
Hungarian grass,	1	–	–	92.55	–	–	9.45	–	–	2.22	–	–	50.64	–	–	31.96	5.73	1:6.22
Barn-yard grass (*Panicum crus-galli* L.),	1	–	–	93.35	–	–	15.27	–	–	1.95	–	–	30.24	–	–	33.72	10.02	1:2.94
Hay of black grass,	1	–	–	91.25	–	–	6.72	–	–	3.37	–	–	49.47	–	–	31.41	9.03	–
Low meadow hay,	1	–	–	91.99	–	–	9.51	–	–	1.88	–	–	46.27	–	–	35.59	6.75	–
Salt hay,	2	91.92	90.34	91.13	4.35	3.77	4.06	3.24	2.65	2.95	60.15	60.14	60.15	27.84	27.82	27.83	5.02	–
Millet,	6	93.85	90.25	92.54	8.88	7.09	7.81	3.63	.89	2.05	55.80	49.62	51.74	35.91	29.80	33.32	5.08	1:7.78
Oats in bloom,	1	–	–	93.57	–	–	6.58	–	–	2.92	–	–	50.03	–	–	34.06	6.41	1 :14.23
Oats in milk,	1	–	–	90.45	–	–	10.89	–	–	2.69	–	–	46.02	–	–	34.32	6.08	1:7.90

A. *Analyses of Fodder Articles* — Continued.

NAME.	Analyses.	DRY MATTER.			ONE HUNDRED PARTS OF DRY MATTER CONTAIN —													Nutritive Ratio (Average).
					PROTEIN.			FAT.			NITROGEN-FREE EXTRACT.			FIBRE.			Ash.	
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
II. Hay and Dry Coarse Fodders — Concluded.																		
Oats, ripe,	1	-	-	**91.30**	-	-	**6.05**	-	-	**2.61**	-	-	**48.92**	-	-	**36.31**	6.11	1:15.03
Winter rye in bloom,	1	-	-	**91.45**	-	-	**10.66**	-	-	**2.57**	-	-	**47.40**	-	-	**32.97**	6.40	1:8.28
Barley in milk,	1	-	-	**89.75**	-	-	**10.26**	-	-	**2.76**	-	-	**52.91**	-	-	**29.12**	4.95	1:9.59
Japanese buckwheat,	1	-	-	**94.29**	-	-	**10.80**	-	-	**2.22**	-	-	**38.60**	-	-	**36.02**	12.36	-
Dry fodder corn,	4	93.35	90.58	**92.11**	9.31	6.17	**7.74**	2.76	1.11	**1.84**	58.89	53.86	**55.97**	33.75	23.03	**29.31**	5.14	1:10.98
Corn stover,	26	94.44	75.00	**88.18**	12.15	5.46	**7.29**	2.63	1.08	**1.38**	63.05	44.65	**50.82**	38.83	20.93	**34.84**	5.67	1:11.62
Teosinte (*Euchlœna luxurians* Dur. and Asch.),	1	-	-	**93.94**	-	-	**9.71**	-	-	**1.28**	-	-	**53.18**	-	-	**28.88**	6.95	-
Mammoth red clover (*Trifolium medium* L.),	3	92.66	82.47	**88.59**	18.50	14.06	**15.75**	2.25	1.86	**2.13**	48.98	46.51	**44.77**	33.72	20.16	**27.51**	9.84	1:5.10
Medium red clover (*Trifolium pratense* L.),	2	94.90	93.98	**94.44**	15.01	14.63	**14.82**	2.62	2.36	**2.49**	43.88	42.81	**43.34**	30.76	29.97	**30.37**	8.98	1:5.52
Alsike clover (*Trifolium hybridum* L.),	6	93.92	86.48	**90.07**	17.55	14.77	**16.63**	3.26	1.88	**2.58**	46.64	38.03	**42.72**	32.34	21.44	**26.17**	11.90	1:3.25
Lucerne (alfalfa) (*Medicago sativa* Desr.),	5	95.40	84.00	**91.40**	16.34	11.12	**14.22**	2.50	1.04	**1.65**	51.62	40.25	**46.20**	34.39	25.42	**29.72**	8.11	1:4.09
Sand lucerne (*Medicago media* Pers.),	1	-	-	**91.20**	-	-	**16.26**	-	-	**2.59**	-	-	**50.31**	-	-	**21.27**	9.57	1:3.50
Bokhara clover (*Melilotus alba* Desr.),	2	93.64	91.50	**92.57**	14.93	11.81	**13.37**	4.79	1.85	**3.32**	51.36	38.83	**45.08**	33.05	28.08	**30.57**	7.66	-
Blue melilot (*Melilotus cœrulea* Desr.),	1	-	-	**91.78**	-	-	**13.81**	-	-	**1.67**	-	-	**43.22**	-	-	**27.17**	14.87	-
Sainfoin (*Onobrychis sativa*),	1	-	-	**87.83**	-	-	**17.70**	-	-	**4.49**	-	-	**42.27**	-	-	**26.95**	8.54	-
Sulla (*Hedysarum coronarium*),	2	91.68	89.59	**90.61**	17.03	16.90	**16.97**	3.16	2.39	**2.78**	58.66	41.89	**50.26**	28.95	12.38	**20.67**	9.32	-

Hairy lotus (*Lotus villosus* Thuill),	2	89.32	87.64	**88.48**	16.12	13.49	**14.81**	3.00	2.69	**2.85**	57.82	50.80	**54.29**	24.48	15.07	**19.78**	8.27	-
Soja bean,	3	93.88	79.91	**89.10**	19.06	15.10	**16.68**	8.33	5.62	**6.77**	51.28	41.09	**46.96**	25.84	20.76	**22.79**	6.90	1:4.23
Cow pea,	3	90.70	90.25	**90.43**	17.17	16.95	**17.05**	4.49	3.81	**4.06**	51.41	46.06	**47.93**	23.58	19.06	**21.67**	9.29	1:4.82
Small pea (*Lathyrus sativus*),	1	-	-	**94.20**	-	-	**16.57**	-	-	**1.49**	-	-	**42.76**	-	-	**32.88**	6.30	-
Serradella,	3	92.80	87.23	**90.44**	17.97	15.26	**17.03**	2.91	2.37	**2.55**	50.23	44.49	**48.18**	25.92	24.37	**25.15**	7.09	1:4.85
Hairy vetch (*Vicia villosa* Roth.),	1	-	-	**92.56**	-	-	**19.58**	-	-	**1.22**	-	-	**38.95**	-	-	**31.88**	8.37	-
Common vetch (*Vicia sativa* L.),	2	91.65	90.55	**91.10**	15.76	14.42	**15.09**	2.69	2.30	**2.50**	44.34	43.29	**43.80**	30.68	30.05	**30.37**	8.24	1:3.87
Scotch tares,	1	-	-	**84.20**	-	-	**22.00**	-	-	**1.89**	-	-	**31.46**	-	-	**30.89**	13.76	-
Vetch and oats,	2	94.22	87.47	**90.85**	7.72	7.70	**7.71**	3.37	2.53	**2.95**	49.95	49.00	**49.47**	36.22	31.73	**33.98**	5.89	1:11.49
Horse-bean straw,	1	-	-	**90.85**	-	-	**9.69**	-	-	**1.51**	-	-	**37.77**	-	-	**41.44**	9.59	1:8.55
Soja-bean straw,	1	-	-	**87.00**	-	-	**5.39**	-	-	**1.80**	-	-	**43.72**	-	-	**43.85**	5.24	-
White daisy (*Chrysanthemum leucanthemum* L.),	1	-	-	**90.35**	-	-	**7.68**	-	-	**2.32**	-	-	**46.86**	-	-	**36.09**	7.05	-
Dry carrot tops,	1	-	-	**90.24**	-	-	**20.12**	-	-	**2.01**	-	-	**50.39**	-	-	**13.61**	13.87	-
Wheat straw,	1	-	-	**93.80**	-	-	**7.20**	-	-	**1.63**	-	-	**50.46**	-	-	**35.91**	4.80	1:8.00
Barley straw,	1	-	-	**88.56**	-	-	**9.24**	-	-	**3.38**	-	-	**48.23**	-	-	**33.85**	5.30	1:26.21
Japanese millet (white head),	1	-	-	**91.48**	-	-	**7.67**	-	-	**2.41**	-	-	**49.87**	-	-	**34.99**	5.06	-
Japanese millet (red head),	1	-	-	**91.13**	-	-	**5.76**	-	-	**1.70**	-	-	**49.66**	-	-	**39.52**	3.36	-
III. Roots, Bulbs, Tubers, etc.																		
Beets, red,	7	14.51	9.75	**12.17**	15.40	7.82	**12.29**	1.76	.59	**.94**	79.33	66.87	**72.19**	7.56	4.29	**6.00**	8.58	1:8.24
Beets, sugar,	11	19.53	9.87	**14.73**	17.44	7.32	**10.97**	.83	.58	**.66**	81.50	61.93	**75.93**	9.69	4.82	**6.49**	5.95	1:11.80
Mangolds,	3	13.08	11.73	**12.25**	12.84	7.83	**10.37**	1.01	.73	**.88**	73.38	70.32	**71.75**	9.54	7.08	**7.94**	9.06	1:8.83
Beets, yellow fodder,	1	-	-	**9.40**	-	-	**12.78**	-	-	**1.80**	-	-	**67.50**	-	-	**7.83**	10.09	1:9.94

A. *Analyses of Fodder Articles* — Continued.

NAME.	Analyses.	Dry Matter.			One Hundred Parts of Dry Matter contain —													Nutritive Ratio (Average).
					PROTEIN.			FAT.			NITROGEN-FREE EXTRACT.			FIBRE.			Ash.	
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
III. Roots, Bulbs, Tubers, etc. — Concluded.																		
Ruta-bagas,	3	12.77	8.25	10.88	11.46	10.34	11.01	2.32	1.23	1.53	68.58	62.27	65.88	13.12	11.03	11.83	9.75	1:11.83
Turnips,	3	12.80	8.22	9.79	10.81	9.67	10.12	2.05	1.42	1.74	70.62	65.91	68.44	12.61	10.12	11.23	8.47	1:13.26
Carrots,	4	12.52	9.95	10.72	9.63	7.98	8.93	3.94	1.67	2.34	73.96	67.24	71.27	10.76	7.55	9.19	8.27	1:9.67
Parsnips,	1	-	-	19.66	-	-	6.88	-	-	3.37	-	-	74.65	-	-	-	7.67	-
Potatoes,	10	21.95	13.91	18.78	13.56	6.24	10.01	.83	.17	.48	87.56	78.80	81.50	3.55	1.91	2.75	5.26	1:12.25
Apples,	2	24.83	19.68	22.26	4.57	3.92	4.25	2.81	1.71	2.26	86.21	83.44	84.81	7.05	6.14	6.60	2.08	1:26.44
IV. Grains and Other Seeds.																		
Corn kernels,	28	91.98	65.50	89.55	15.02	8.49	12.24	9.43	4.25	5.47	83.98	71.06	78.44	3.38	1.03	2.14	1.71	1:8.16
Corn and cob meal,	37	94.00	80.89	89.47	15.06	7.82	10.01	5.27	3.36	4.19	81.41	70.13	76.62	10.41	5.63	7.54	1.64	-
Wheat kernels,	1	-	-	89.42	-	-	13.35	-	-	1.79	-	-	80.20	-	-	2.42	2.18	1.6.42
Broom-corn seed,	1	-	-	85.90	-	-	11.21	-	-	4.05	-	-	74.05	-	-	8.34	2.35	-
Soja beans,	3	94.15	80.73	85.83	35.98	32.58	33.97	21.89	18.42	20.19	34.88	32.87	33.98	7.57	5.15	6.02	5.84	1:2.61
Horse beans,	1	-	-	89.72	-	-	30.03	-	-	1.11	-	-	56.48	-	-	8.11	4.27	1:2.24
Red adzinki beans,	2	85.18	83.10	84.14	25.14	23.75	24.45	.88	.76	.82	66.48	65.41	65.95	4.68	4.50	4.59	4.19	-
Saddle beans,	1	-	-	87.62	-	-	15.12	-	-	16.58	-	-	57.34	-	-	4.75	6.21	-

Daidzu beans,	1	-	-	88.47	-	-	38.99	-	-	18.59	-	-	30.41	-	-	4.97	7.04	-
Millet seed,	3	87.32	86.11	86.65	14.60	11.76	13.24	4.94	3.53	4.32	73.19	66.94	70.56	10.23	6.48	8.88	3.00	-
Chestnuts,	1	-	-	55.14	-	-	13.32	-	-	14.46	-	-	67.05	-	-	2.45	2.72	-
V. Flour and Meal.																		
Corn meal,	27	89.95	82.96	85.99	16.08	9.73	11.08	5.08	3.10	4.50	83.24	73.20	80.53	3.60	1.20	2.19	1.70	-
Hominy meal,	4	91.89	88.68	90.23	11.88	6.77	10.41	12.22	4.89	9.81	78.07	68.00	73.00	5.12	3.69	4.34	2.44	-
Ground barley,	3	87.81	82.59	85.59	14.93	10.42	12.17	2.38	1.69	2.09	78.25	74.47	76.69	7.37	5.04	6.42	2.63	-
Broom-corn meal,	1	-	-	86.46	-	-	11.14	-	-	4.13	-	-	74.30	-	-	8.00	2.43	-
Pea meal,	1	-	-	91.15	-	-	20.95	-	-	1.67	-	-	55.02	-	-	19.42	2.94	-
VI. By-products and Refuse.																		
Linseed cake, old process,	7	92.52	88.50	90.54	39.97	30.98	36.64	9.87	6.24	7.16	44.72	37.76	40.61	9.69	8.04	8.68	6.91	1:1.66
Linseed cake, new process,	5	94.94	88.17	92.05	41.02	35.03	39.18	4.08	2.17	3.12	46.49	40.83	41.87	10.31	8.93	9.38	6.45	1:1.32
Cotton-seed meal, decorticated,	14	93.16	88.81	91.32	51.79	36.54	44.43	14.72	9.57	12.23	33.87	20.22	27.18	10.83	6.28	8.11	8.05	1:1.39
Wheat bran,	32	92.58	86.30	89.44	20.54	15.67	17.71	6.08	2.80	4.99	62.18	51.77	59.39	14.26	7.49	10.90	7.01	-
Wheat middlings,	6	90.75	87.57	89.93	19.21	15.13	16.72	6.46	3.19	5.31	74.30	58.03	61.77	11.21	1.40	9.21	6.99	1:4.21
Rye bran,	2	91.82	86.30	89.06	18.98	16.52	17.75	3.03	2.07	2.55	73.56	69.24	71.70	4.54	3.46	4.00	4.30	1:4.88
Rye middlings,	1	-	-	87.46	-	-	13.15	-	-	5.61	-	-	73.52	-	-	3.70	4.02	1:7.28
Buckwheat middlings,	1	-	-	88.49	-	-	25.49	-	-	7.53	-	-	66.36	-	-	5.18	5.44	-
Gluten meal,	22	93.50	68.32	90.36	39.28	25.94	32.06	12.05	3.92	7.35	66.26	48.26	58.62	5.43	.41	1.26	.71	1:2.75
Maize feed,	1	-	-	90.25	-	-	21.33	-	-	6.15	-	-	62.12	-	-	9.65	.75	1:4.49
Corn germ meal,	1	-	-	90.65	-	-	28.26	-	-	11.82	-	-	42.49	-	-	9.18	8.25	-

A. Analyses of Fodder Articles — Concluded.

NAME.	Analyses.	DRY MATTER.			ONE HUNDRED PARTS OF DRY MATTER CONTAIN —													Nutritive Ratio (Average).
					PROTEIN.			FAT.			NITROGEN-FREE EXTRACT.			FIBRE.			Ash.	
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
VI. By-products and Refuse — Concluded.																		
Bakery refuse,	1	-	-	86.66	-	-	9.23	-	-	6.36	-	-	72.34	-	-	.43	11.64	-
Vinegar mash,	1	-	-	5.51	-	-	16.50	-	-	8.45	-	-	63.47	-	-	8.55	3.03	-
Refuse from starch works,	1	-	-	42.96	-	-	22.41	-	-	10.17	-	-	58.98	-	-	7.54	.90	-
Spent brewer's grain,	4	93.02	88.00	90.13	33.16	16.08	23.29	6.29	1.95	4.89	67.62	42.32	54.04	15.90	8.07	11.25	4.53	1:2.90
Cocoa dust from cocoa manufactory,	1	-	-	92.90	-	-	15.47	-	-	25.85	-	-	45.99	-	-	5.86	6.83	-
Broom-corn waste,	1	-	-	91.30	-	-	6.78	-	-	1.00	-	-	48.09	-	-	39.25	4.88	-
Cotton hulls,	2	89.83	88.55	89.10	5.36	4.90	5.13	4.27	2.36	3.31	46.75	38.59	42.67	51.40	40.24	45.82	3.07	1:28.16
Apple pomace,	2	21.78	17.22	19.50	7.73	6.94	7.34	4.37	3.17	3.78	72.93	70.20	72.56	16.58	13.15	14.86	1.46	-
Apple pomace ensilage,	1	-	-	14.67	-	-	8.22	-	-	7.36	-	-	58.03	-	-	22.18	4.21	-
Sugar beet pulp, from diffusion battery,	1	-	-	10.32	-	-	12.41	-	-	.95	-	-	61.86	-	-	23.74	1.04	-
Corn cobs,	4	-	-	90.00	4.15	3.00	3.57	.67	.38	.57	63.62	60.58	61.78	33.77	31.36	32.93	1.21	1:30.85
Palmetto root,	1	-	-	88.49	-	-	3.82	-	-	.53	-	-	69.95	-	-	21.26	4.44	-

B. *Analyses of Fodder Articles with Reference to Fertilizing Ingredients.*

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	*Valuation per 2,000 Pounds.
I. Green Fodders.												
Fodder corn,	14	78.61	.407	4.84	.327	.048	.153	.091	.018	.148	.380	$1 65
Fodder corn ensilage,	1	71.60	.360	–	.330	.050	.100	.090	.020	.140	.040	1 53
Corn and soja bean ensilage,	1	71.03	.790	–	.444	–	–	–	–	.420	–	3 23
Sorghum,	7	82.19	.233	–	.229	.025	.076	.075	.012	.088	.136	1 00
White kibi,	2	76.45	.489	1.22	.200	.045	.232	.148	.019	.136	.652	1 79
Mochi millet,	3	62.58	.609	2.62	.407	.120	.201	.217	.021	.188	.708	2 50
Mix,	3	75.59	.499	1.54	.363	.060	.249	.245	.021	.237	.527	2 08
Green oats,	3	83.36	.489	1.31	.381	.217	.154	.134	.018	.130	.496	1 95
Vetch and oats,	1	86.11	.236	1.72	.789	.031	.087	.030	.012	.094	.331	1 53
Horse bean,	1	74.71	.675	–	1.370	.090	1.370	.620	.200	.330	2.040	3 62
Cow-pea vines,	1	78.81	.274	1.47	.306	.063	.300	.099	.016	.098	.077	1 21
Serradella,	2	82.59	.411	1.82	.420	.097	.460	.067	.021	.140	.097	1 77
White lupine,	1	85.35	.440	–	1.730	.680	3.070	.730	.170	.350	.900	3 26
Spanish moss,	1	60.80	.279	1.04	.255	.263	.089	.122	.029	.030	.191	1 10

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* The valuation is based on the following prices per pound of the essential fertilizing ingredients: Nitrogen, 15 cents; potassium oxide, 4½ cents; phosphoric acid, 5½ cents.

B. Analyses of Fodder Articles with Reference to Fertilizing Ingredients — Continued.

NAME.	Analyses.	Moisture.	Nitrogen	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Valuation per 2,000 Pounds.
II. Hay and Dry Course Fodders.												
English hay,	9	11.99	1.409	6.34	1.550	.110	.344	.240	.021	.269	.980	$5 92
Rowen,	12	18.52	1.609	9.57	1.486	.140	.640	.280	.034	.432	1.840	5 64
Timothy hay,	3	11.26	1.240	4.93	1.460	.180	.620	.120	.006	.342	1.000	5 41
Red-top,	4	7.71	1.150	4.59	1.020	.438	.571	.134	.036	.360	1.736	4 76
Kentucky blue-grass,	2	5.34	1.320	–	1.694	.129	.398	–	.044	.431	2.863	5 95
Orchard grass,	4	8.84	1.310	6.42	1.879	.225	.456	.297	.033	.414	2.060	6 08
Meadow fescue,	6	8.89	.992	8.08	2.096	.301	.576	.187	.028	.399	1.537	5 30
Perennial rye grass,	2	9.13	1.227	6.79	1.553	.307	.642	.337	.044	.559	2.262	5 69
Italian rye-grass,	4	8.71	1.189	–	1.273	.451	.857	.321	.071	.556	2.598	5 32
Salt hay,	1	5.36	1.180	–	.718	.017	.371	.335	.028	.248	–	4 46
Japanese millet (white head).	3	10.45	1.105	5.80	1.223	.012	.465	.377	.028	.403	1.633	4 86
Japanese buckwheat,	1	5.72	1.629	–	3.320	.349	3.418	.421	.148	.852	.378	8 81
Fodder corn,	7	7.85	1.763	4.91	.889	.175	.605	.500	.075	.542	1.270	6 69
Corn stover,	16	9.12	1.043	3.74	1.400	.112	.622	.384	.068	.293	1.885	4 71
Teosinte,	1	6.06	1.460	6.53	3.656	.109	1.597	.458	.021	.546	.315	8 31
Millet hay,	1	9.75	1.280	–	1.690	.020	.500	.460	.030	.490	1.360	5 90

Mammoth red clover,	3	11.49	**2.231**	8.72	**1.223**	.389	3.141	.613	.111	**.546**	.779	8 39
Medium red clover,	2	7.91	**2.184**	8.36	**2.286**	.210	1.689	.402	.099	**.447**	.919	9 10
Alsike clover,	6	9.94	**2.342**	11.11	**2.227**	.309	2.153	.537	.197	**.668**	1.776	9 77
Lucerne (alfalfa),	4	6.26	**2.075**	6.82	**1.461**	.814	2.211	.406	.078	**.526**	.513	8 12
Bokhara clover,	2	7.43	**1.975**	7.70	**1.832**	.114	1.784	.347	.023	**.558**	.057	8 19
Blue melilot,	1	8.22	**1.919**	13.65	**2.796**	.270	1.449	.260	.349	**.544**	4.008	8 87
Sainfoin,	1	12.17	**2.630**	7.55	**2.020**	.540	1.160	.430	.040	**.760**	.470	10 54
Sulla,	2	9.39	**2.460**	-	**2.093**	.223	2.497	.350	.114	**.453**	.614	9 70
Lotus villosus,	2	11.52	**2.095**	8.23	**1.807**	.499	2.220	.476	.112	**.594**	.976	8 56
Soja bean,	2	6.30	**2.320**	6.47	**1.079**	.148	2.760	1.178	.115	**.667**	.977	8 66
Cow-pea,	1	9.00	**1.635**	8.40	**.913**	.122	2.696	.688	.046	**.527**	.832	6 31
Small pea,	1	5.80	**2.497**	-	**1.990**	.469	1.373	.276	.138	**.592**	1.081	9 93
Serradella,	2	7.39	**2.697**	10.60	**.652**	.656	2.545	.461	.066	**.777**	.590	9 83
Scotch tares,	1	15.80	**2.964**	-	**3.004**	.238	1.698	.354	.460	**.815**	4.062	12 49
Vetch and oats,	3	9.91	**1.299**	9.58	**1.349**	.420	.663	.265	.098	**.560**	.521	5 72
Soja-bean straw,	1	13.00	**.750**	-	**1.322**	-	.436	.469	.035	**.397**	.218	3 88
White daisy,	1	9.65	**.279**	6.37	**1.253**	.164	1.302	.191	.032	**.435**	1.110	2 44
Dry carrot tops,	1	9.76	**3.130**	12.52	**4.883**	4.028	2.089	.067	.118	**.612**	.098	14 46
Barley straw,	1	11.44	**1.310**	5.30	**2.086**	.183	.572	.180	-	**.303**	2.380	6 14
III. Roots, Bulbs, Tubers, etc.												
Beets, red,	7	87.73	**.243**	1.13	**.436**	.091	.049	.033	.004	**.091**	.020	1 22
Beets, sugar,	4	86.95	**.223**	1.04	**.477**	.081	.057	.040	.013	**.101**	.048	1 21

B. Analyses of Fodder Articles with Reference to Fertilizing Ingredients — Continued.

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Valuation per 2,000 Pounds.
III. Roots, Bulbs, Tubers, etc. — Concluded.												
Beets, yellow fodder,	1	90.60	.192	.95	.462	.104	.045	.030	.005	.086	.015	$1 09
Mangolds,	2	87.29	.188	1.22	.383	.125	.061	.039	.005	.093	.023	1 01
Ruta-bagas,	3	89.13	.190	1.06	.489	.070	.088	.030	.004	.123	.012	1 15
Turnips,	2	89.49	.178	1.01	.385	.078	.089	.027	.009	.104	.055	0 99
Carrots,	2	89.79	.147	9.22	.506	.062	.067	.023	.009	.093	.019	1 00
Parsnips,	1	80.34	.217	-	.617	.006	.088	.045	.005	.187	.019	1 41
Potatoes,	1	79.75	.207	.99	.294	.013	.007	.020	.002	.066	.006	0 96
Apples,	2	79.91	.130	.41	.190	.030	.030	.030	.003	.010	.003	0 57
IV. Grains and Other Seeds.												
Corn kernels,	13	10.88	1.822	1.53	.404	.034	.032	.206	.019	.699	.020	6 60
Corn and cob meal,	29	8.96	1.409	-	.472	.059	.018	.176	.011	.571	.430	5 28
Soja beans,	2	18.33	5.303	4.99	1.991	.275	.419	.909	.216	1.869	.093	19 75
Red adzinki beans,	1	14.82	3.240	-	1.540	.035	.090	.210	.180	.940	.050	12 14
White adzinki beans,	1	16.90	3.330	-	1.480	.190	.130	.220	.021	.970	.130	12 39
Saddle beans,	1	12.38	2.120	-	2.130	.020	.250	.430	.032	1.520	.250	9 95

Daidzu beans,	1	11.53	5.520	-	1.960	.210	.220	.400	.050	1.480	.280	19 95
Japanese millet,	2	13.68	1.730	-	.380	.030	.045	.225	.015	.685	-	6 22
Common millet,	1	12.68	2.040	-	.360	.060	.040	.260	.030	.850	.143	7 38
Chestnuts,	1	44.86	1.175	2.72	.632	-	.060	.135	.010	.392	.069	4 53
V. Flour and Meal.												
Corn meal,	2	13.52	2.050	1.42	.435	.064	.034	.187	.015	.707	.005	7 31
Hominy feed,	1	8.93	1.630	2.21	.490	-	.180	.280	-	.980	-	6 41
Ground barley,	1	13.43	1.550	2.06	.341	.169	.091	.173	.013	.660	.669	5 68
Wheat flour,	1	9.83	2.210	1.22	.540	-	.170	.050	-	.570	-	7 74
Pea meal,	1	8.85	3.080	2.68	.993	.618	.302	.302	.027	.820	.122	11 04
VI. By-products and Refuse.												
Linseed cake, old process,	4	8.02	5.390	6.57	1.214	.860	.664	.763	.060	1.780	.340	19 22
Linseed cake, new process,	4	7.35	5.808	5.04	1.288	.823	.663	.655	.062	1.628	.345	20 37
Cotton-seed meal,	9	8.96	6.467	6.49	1.723	.291	.587	.589	.020	2.333	.457	23 52
Wheat bran,	5	11.39	2.879	6.44	1.625	.159	.168	.899	.019	2.845	.141	13 23
Wheat middlings,	1	9.18	2.630	2.30	.630	.110	.200	.210	-	.950	-	9 50
Rye middlings,	1	12.54	1.840	3.52	.810	.030	.090	.320	.020	1.260	.170	7 63
Gluten meal,	5	8.53	5.090	.65	.047	.018	.050	.035	.009	.420	-	15 77
Spent brewer's grain,	2	8.58	2.680	6.15	.853	.347	.296	.286	.159	1.045	1.770	9 96
Cocoa dust,	1	7.10	2.299	6.35	.630	-	.630	-	-	1.340	-	8 94
Broom corn waste (stalks),	1	10.37	.870	4.70	1.858	-	.242	.170	-	.460	1.000	4 79

B. Analyses of Fodder Articles with Reference to Fertilizing Ingredients — Concluded.

NAME.	Analyses.	Moisture.	Nitrogen.	Ash.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Valuation per 2,000 Pounds.
VI. By-products and Refuse — Concluded.												
Cotton hulls,	3	10.63	.750	2.61	1.080	-	.200	.260	-	.180	.060	$3 42
Apple pomace,	2	80.50	.227	.271	.134	.026	.037	.028	.008	.018	.009	0 82
Corn cobs,	8	12.09	.504	.815	.598	.071	.025	.045	.009	.063	.190	2 12
Palmetto roots,	1	11.51	.540	3.93	1.380	.345	.045	.004	.017	.157	.410	3 03
Buckwheat hulls,	1	11.90	.490	-	.521	-	.247	.236	.020	.073	.066	2 02

C. Analyses of Fruits.

NAME.	Date.	Dry Matter.	Specific Gravity of Juice.	Temperature C. of Juice (Degrees).	Total Sugar in Juice.	Glucose in Juice.	Cane Sugar in Juice.	*Soda Sol. required to neutralize 100 parts Juice.
	1877.	Per ct.			Per ct.	Per ct.	Per ct.	C. C.
Apple (Baldwin),	Sept. 1,	20.14	1.055	12—15	3.09	–	–	–
Apple (Baldwin),	Oct. 9,	19.66	1.065	12—15	6.25	–	–	–
Apple (Baldwin),	Nov. 27,	–	1.075	12—15	10.42	–	–	–
Rhode Island Greening,	Sept. 1,	20.27	1.055	12—15	3.16	–	–	–
Rhode Island Greening,	Oct. 9,	19.68	1.066	12—15	7.14	–	–	–
Rhode Island Greening,†	Nov. 27,	20.25	1.080	12—15	11.36	–	–	–
Pear (Bartlett),	Aug. 31,	15.00	1.060	12—15	4.77	–	–	–
Pear (Bartlett),	Sept. 7,	16.55	1.060	12—15	5.68	–	–	–
Pear (Bartlett),	Sept. 20,	–	1.065	12—15	8.62	–	–	–
Pear (Bartlett),‡	Sept. 22,	–	1.060	12—15	8.93	–	–	–
Cranberries,	–	10.71	1.025	15	1.35	–	–	–§
Cranberries,	1878.	10.11	1.025	15	1.70	–	–	–‖
Early York Peach (ripe),	–	–	1.045	25	–	1.92	6.09	45
Early York Peach (nearly ripe),	–	10.96¶	1.039	25	–	1.36	4.12	42.3
Crawford Peach (nearly ripe),	–	–	1.050	18	–	2.19	7.02	85.6
Crawford Peach (mellow),	–	11.36¶	1.055	18	–	1.70	8.94	76
Crawford Peach (not mellow),	–	11.88¶	1.045	22	–	1.67	5.92	64

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* One part Na_2CO_3 in 100 parts of water.

† Picked October 9.

‡ Picked September 7.

§ Free acid, 2.25 per cent.

‖ Free acid, 2.43 per cent.

¶ In pulp, kept ten days before testing.

C. Analyses of Fruits — Continued.

[Wild and cultivated grapes.]

NAME.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter.	Glucose in Juice.	Sugar in Dry Matter.	*Sod. Sol. requir-ed to neutralize 100 parts Juice.
	1876.			Per ct.	Per ct.	Per ct.	C.C.
Concord,	July 17,	1.0175	31	8.30	.645	7.77	-
Concord,	July 20,	1.0150	31	8.10	.625	7.72	216
Concord,	Aug. 2,	1.0200	25	9.94	.938	9.44	249
Concord,	Aug. 16,	1.0250	28	10.88	2.000	18.38	229
Concord,	Aug. 30,	1.0500	25	15.58	8.620	55.33	120
Concord,	Sept. 13,	1.0670	23	17.48	13.890	79.46	55
Concord,	Sept. 4,	1.0700	18	19.82	16.130	81.38	49.2
Wild Purple Grape,	July 19,	1.020	31	9.00	.714	7.93	204
Wild Purple Grape,	Aug. 4,	1.020	28	12.25	1.100	8.98	246
Wild Purple Grape,	Aug. 16,	1.025	28	12.48	2.000	16.03	233
Wild Purple Grape,	Aug. 30,	1.050	26	16.58	6.500	39.81	147.6
White Wild Grape,	Aug. 31,	1.050	26	16.48	9.260	56.18	98
Hartford Prolific,	Sept. 5,	1.060	22	17.39	13.89	79.87	88.8
Ives' seedling,	Sept. 6,	1.070	26	20.15	15.15	75.14	88.6
Iona,	Sept. 7,	1.080	21	24.56	15.15	61.68	144
Iona (mildewed),	Sept. 7,	1.045	26	15.41	6.25	40.56	204.4
Agawam,	Sept. 11,	1.075	20	20.79	17.24	82.92	94.8
Wilder,	Sept. 11,	1.064	20	16.53	13.67	82.69	56
Delaware,	Sept. 12,	1.080	24	23.47	17.86	76.09	74
Charter Oak,	Sept. 12,	1.080	24	15.98	8.77	54.94	168.3
Israella,	Sept. 16,	1.075	23	19.67	9.20	46.77	89.8
Bent's Seedling,	Sept. 20,	1.080	21	20.65	16.13	78.11	181.8
Adirondack,	Sept. 20,	1.065	21	15.11	13.17	87.16	68
Catawba,	Oct. 16,	1.080	13	23.45	17.39	74.16	82
	1877.						
Wilder,	Sept. 11,	1.065	23	16.41	15.15	92.32	60
Charter Oak,	Sept. 12,	1.055	23	16.22	9.80	60.42	96
Concord,	Sept. 13,	1.065	24	15.90	13.16	82.76	102
Concord,	Sept. 26,	1.075	24	19.34	15.43	79.78	70.8
Eumalan,	Sept. 24,	1.065	16	19.62	13.16	67.07	73
Wild White Grape,	Sept. 5,	1.050	22	15.57	7.20	46.24	140.8
Wild White Grape (shrivelled),	Sept. 20,	1.060	16	20.02	10.00	49.95	130
Wild Purple Grape (shrivelled),	Sept. 20,	1.045	16	16.69	8.22	49.25	104

* One part of pure $Na_2\ CO_3$ in 100 parts water.

C. Analyses of Fruits — Continued.

[Effect of girdling on grapes.]

NAME AND CONDITION.	Date.	Specific Gravity.	Temperature C. (Degrees).	Dry Matter at 100° C.	Glucose in Juice.	Sugar in Dry Matter.	*Soda Sol. required to neutralize 100 parts Juice.
	1877.			Per ct.	Per ct.	Per ct.	C. C.
Hartford Prolific, not girdled, .	Sept. 3,	1.045	19	12.85	8.77	68.25	111.4
Hartford Prolific, girdled, . .	Sept. 3,	1.065	19	17.18	12.50	72.76	100
Wilder, not girdled, . . .	Sept. 3,	1.055	19	15.41	10.42	67.62	108.2
Wilder, girdled, ...	Sept. 3,	1.075	19	17.24	14.70	85.26	88.4
Delaware, not girdled, . . .	Sept. 4,	1.065	19	15.75	11.76	74.66	101.2
Delaware, girdled, ...	Sept. 4,	1.075	19	19.14	15.15	79.16	94.4
Agawam, not girdled, . . .	Sept. 4,	1.060	19	16.60	11.37	68.48	128.2
Agawam, girdled, ...	Sept. 4,	1 075	19	18.45	16.31	87.42	114.8
Iona, not girdled, ...	Sept. 6,	1.0625	22	16.60	13.51	68.31	131.4
Iona, girdled, ...	Sept. 6,	1.085	22	21.48	15.63	72.76	125.6
Concord, not girdled, . . .	Sept. 6,	1.045	22	13.46	7.46	55.42	182.4
Concord, girdled, ...	Sept. 6,	1.070	22	17.53	13.88	79.18	102.8
Concord, not girdled, . . .	Sept. 26,	1.065	22	17.63	13.70	78.27	86
Concord, girdled, ...	Sept. 26,	1.080	22	24.47	19.61	80.13	76.8
Concord, not girdled, . . .	Oct. 5,	1.075	12	20.92	17.50	85.37	42
Concord, girdled, ...	Oct. 5,	1.085	12	–	17.86	–	54

	Date.	100 Parts of Grapes contained —			
		Ash.	Moisture.	Glucose.	Tartaric Acid.
	1889.				
Concord, not girdled, . . .	Sept. 23,	–	84.69	6.24	.75
Concord, girdled, ...	Sept. 23,	.42	83.00	8.13	.85
Concord, not girdled, . . .	Oct. 8,	.53	84.51	6.09	.48
Concord, girdled, ...	Oct. 8,	.37	82.69	8.50	.50
	1890.				
Concord, not girdled, . . .	Sept. 25,	.47	86.49	7.36	1.15
Concord, girdled, ...	Sept. 25,	.48	84.93	9.29	1.17
Concord, not girdled, . . .	Oct. 9,	.53	85.39	7.67	.71
Concord, not girdled, . . .	Oct. 9,	.59	85.11	6.65	.51
Concord, girdled, ...	Oct. 9,	.54	85.15	9.12	.74

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* One part of pure $Na_2 CO_3$ in 100 parts water.

C. Analyses of Fruits — Continued.

[Effect of fertilization upon the organic constituents of wild grapes.]

NAME.	Date.	Dry Matter.	Specific Gravity.	Temperature C. (Degrees).	Per Cent. of Glucose.	Per Cent. of Acids.	Remarks.
	1877.						
Wild Purple Grape Berries, .	Sept. 20,	16.31	-	-	8.03	-	Unfertilized.
Wild Purple Grape Berries, .	"	19.55	-	-	13.51	-	Fertilized.
Wild Purple Grape Juice, .	"	-	1.045	16	8.22	9 840	Unfertilized.
Wild Purple Grape Juice, .	"	-	1.065	16	13.51	1.149	Fertilized.
Wild White Grape Berries, .	"	20.02	-	-	-	-	Unfertilized.
Wild White Grape Berries, .	"	21.65	-	-	-	-	Fertilized.
Wild White Grape Juice, .	"	-	1.060	16	10.00	1.846	Unfertilized.
Wild White Grape Juice, .	"	-	-	-	14.29	.923	Fertilized.

[Effect of fertilization upon the ash constituents of grapes.]

NAME.	Date.	Potassium Oxide.	Sodium Oxide.	Calcium Oxide.	Magnesium Oxide.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.	Remarks.
	1876.								
Wild Purple Grapes,	Sept. 13,	50.93	.15	22.23	5.59	.79	17.40	2.93	Unfertilized.
Wild Purple Grapes,	Sept. 20,	62.65	.85	14.24	3.92	.53	13.18	4.63	Fertilized.
Concord Grapes, .	July 7,	41.73	5.04	25.03	7.80	.55	18.48	1.37	Unfertilized.
Concord Grapes, .	July 17,	47.34	1.13	24.21	-	.75	21.38	.43	Unfertilized.
Concord Grapes, .	Aug. 18,	51.14	3.19	16.20	6 38	.65	20.77	1.67	Unfertilized.
Concord Grapes, .	Sept. 13,	57.15	4.17	11.30	3.10	.40	12.47	11.82	Unfertilized.
	1878.								
Concord Grapes, .	Oct. 3,	64.65	1.42	9.13	3.63	.50	14.87	5.80	Fertilized.

C. Analyses of Fruits — Concluded.

[Ash analyses of fruits and garden crops.]

NAME.	Ash.	100 PARTS OF ASH CONTAINED —						
		Potash.	Soda.	Lime.	Magnesia.	Ferric Oxide.	Phosphoric Acid.	Insoluble Matter.
Concord Grape (fruit),	–	51.14	3.19	16.20	6.38	.65	20.77	1.67
Unfermented juice,	–	50.85	.48	3.69	4.25	.10	6.43	.90
Fermented juice,	–	40.69	–	6.85	6.24	–	9.04	–
Skins and pulp,	–	7.70	.42	57.36	8.80	.08	24.40	1.32
Seeds,	3.08	6.71	–	–	3.03	–	17.20	.29
Stems of grapes,	4.69	20.91	–	20.20	8.45	–	17.75	2.09
Young branches,*	–	24.71	.94	40.53	10.66	1.08	17.16	4.92
Wood of vine,†	2.97	22.57	–	9.72	4.28	–	14.07	23.84
Concord Grapes, 1891,‡	.55	49.76	–	3.50	2.53	1.19	13.56	2.01
Clinton Grape (fruit),	–	58.45	3.51	13.34	7.37	.90	18.19	–
Baldwin Apple,	–	63.54	1.71	7.28	5.52	1.08	20.87	3.68
Strawberry (fruit),§	.52	49.24	3.23	13.47	8.12	1.74	18.50	5.66
Strawberry (fruit),‖	–	58.47	–	14.64	6.12	3.37	17.40	–
Strawberry vines,	3.34	10.62	13.35	36.63	3.83	6.91	14.48	14.17
Cranberry (fruit),	.18	47.96	6.58	18.58	6.78	–	14.27	–
Cranberry vines,	2.45	12.98	3.27	16.49	10.33	3.35	10.94	34.04
Currants, red,	.47	47.68	4.02	18.96	6.23	1.20	21.91	–
Currants, white,	.59	52.79	3.00	17.08	5.68	2.67	18.78	–
Crawford Peach, sound,	–	74.46	–	2.64	6.29	.58	16.02	–
Crawford Peach, diseased,¶	–	71.30	–	4.68	5.49	.46	18.07	–
Branch, sound,	–	26.01	–	54.52	7.58	.52	11.37	–
Branch, diseased,¶	–	15.67	–	64.23	10.28	1.45	8.37	–
Carnation Pinks (whole plant),**	8.80	38.07	12.84	18.64	3.98	.34	5.23	.24
Asparagus stems,	–	42.94	3.58	27.18	12.77	1.22	12.31	.08
Asparagus roots,	–	56.43	5.42	15.48	7.57	–	15.09	3.67
Onions,	–	38.51	1.90	8.20	3.65	.58	15.80	3.33

* With tendrils and blossoms.

† One year old.

‡ Nitrogen in dry matter, .96 per cent.

§ Wilder.

‖ Downing.

¶ Yellows.

** Nitrogen in dry matter, 1.15 per cent.

D. Analyses of Sugar-producing Plants.

[Composition of sugar beets raised upon the college grounds during the season of 1870 and 1871.]

NAME.	Date.	Brix Saccharometer (Degrees).	Per Cent. of Sugar.	Non-saccharine Substances.
Electoral, ...	Sept. 10,	14	12.30	1.75
Imperial, ...	" 12,	15	12.59	2.41
Vilmorin, ...	" 13,	14.5	12.95	1.55
Imperial, ...	" 18,	14	10.79	3.21
Imperial, ...	Oct. 11,	15	12.05	2.95
Electoral, ...	" 16,	15	12.22	2.78
Vilmorin, ...	" 18,	16	13.13	2.87
Imperial, ...	Nov. 14,	15	11.60	3.34
Vilmorin, ...	" 21,	15.5	13.12	2.38
Vienna Globe,*	Sept. 19,	11	8.00	3.00
Common Mangold,* . . .	" 19,	9	5.00	3.97

* Fodder beets.

[Percentage of sugar in different varieties of sugar beets grown on college farm during the season of 1882.]

NAME.	Source of Seed.	Weight in Pounds.	Per Cent. of Sugar in Juice.
I. Vilmorin, ...	Saxony, .	¾ to ⅞	15.50
II. Vilmorin, ...	Saxony, .	¾ to 1	15.61
I. White Imperial, ...	Saxony, .	¾ to 1¾	14.20
II. White Imperial, ...	Saxony, .	1¾ to 2	10.27
New Imperial, ...	Saxony, .	1¼ to 1¾	13.80
I. White Magdeburg, ...	Saxony, .	1½ to 2	13.10
II White Magdeburg, ...	Silesia, .	1½ to 1¾	10.06
Quedlinburg, ...	Saxony, .	1½ to 1¾	13.44
White Silesian, ...	Silesia, .	1¼ to 1½	9.72

D. Analyses of Sugar-producing Plants — Continued.

[Effect of soil and fertilization on Electoral sugar beets.*]

SOIL.	MANURE.	Specific Gravity Brix (Degrees).	Per Cent. of Sugar in Juice.	Non-saccharine Substances.	Cane Sugar in Soluble Matter.
Sandy loam,	Fresh yard-manure,	16.5	12.50	4.00	75.08
Clayish loam,	Fresh yard-manure,	15.5	11.05	4.45	71.30
Warm alluvial,	Yard-manure and chemicals,	12.75	9.17	3.58	71.92
Warm alluvial,	Fresh hog-manure,	13.5	9.53	3.97	70.06
Light, sandy soil,	No manure,	18.5	13.73	4.77	74.21
Alluvial soil,	Brighton fish,	14.5	11.15	3.35	76.90
Heavy soil,	Yard-manure,	12.25	8.15	4.10	66.53
–	–	13.5	9.90	3.60	73.33

* Not raised on college farm (Connecticut valley).

[Effect of fertilization on sugar beets.*]

FERTILIZERS.	PERCENTAGES OF SUGAR IN JUICE.		
	Freeport.	Electoral.	Vilmorin.
Fresh horse-manure,	11.96	9.42	7.80
Blood guano without potash,	10.99	10.10	10.20
Blood guano with potash,	12.55	13.24	10.50
Kainite and superphosphate,	13.15	12.16	10.50
Sulphate of potash,	14.52	14.32	12.78
Second year after stable-manure,	13.49	12.78	12.19

* All were grown on the same soil, — sandy loam (college).

D. Analyses of Sugar-producing Plants — Continued.

[Effect of different modes of cultivation on Electoral sugar beets.]

Locality of Beet-field.	Date.	Brix Saccharometer (Degrees).	Per Cent. of Cane Sugar.	Non-saccharine Substances.
1. Sing Sing, N. Y , . . .	1872–73	11	7.80	3.20
2. Washington, N. Y ,. . .	"	14	10.97	3.03
3. South Hartford, N. Y., . .	"	15	11.70	3.30
4. Greenwich, N. Y., . . .	"	12	9.50	2.50
5. Frankfort, N. Y., . . .	"	13.5	11.00	2.50
6. Albion, N. Y.,* . . .	"	18	15.10	2.90
Albion, N. Y.,† . . .	"	14	9.70	4.30

* From beets weighing from 1½ to 2 pounds. † From beets weighing from 10 to 14 pounds.

1. Soil, loam resting on clayish hard-pan, had been for several years in grass. Tomatoes had been the preceding crop. Five hundred pounds of a phosphatic blood guano were applied before planting.

2. Soil, a clayish loam, had been ploughed seven inches deep. A liberal amount of rotten sheep-manure was placed in trenches and covered by running two furrows together, thus forming a ridge on which the seed were planted.

3. Soil, a gravelly loam, which had been richly manured with stable compost and twice ploughed before planting.

4. Soil, a sandy loam, underlaid by fine sand. The seed were planted on ridges, which covered trenches containing a little rotten stable-manure.

5. No details of modes of cultivation received.

6. Soil, a dark, reddish-brown, rich, deep, sandy loam. Clover had been raised for two years previous to a crop of carrots, which preceded the sugar beets. The beets were the second crop after the application of twenty loads of stable-manure per acre.

Composition of Canada-grown Sugar Beets.

[1872 and 1873.]

Where Grown.	Weight of Roots.	Specific Gravity of Juice (Brix).	Temperature of Juice.	Per Cent. of Cane Sugar in Juice.
Echaullon de Montreal, . .	2 to 2½ lbs.	15.4°	64° F.	11.38
Riviere du Loup, . . .	2 to 3¼ lbs.	14.5°	63° F.	10.20
Chambly, ...	2 to 2½ lbs.	13.2°	63° F.	9.02
Maskinonge, ...	2 to 3 lbs.	13.4°	63° F.	8.83

D. Analyses of Sugar-producing Plants — Continued.

[Early Amber Cane.]

Date.	Condition of Cane.	Brix Saccharometer (Degrees).	Temperature C. (Degrees).	Glucose.	Cane Sugar.	Soda solution required to neutralize 100 parts of Juice.	Solids.
1879.				Per ct.	Per ct.	C. C.	Per ct.
Aug. 15,	No flower stalks in sight, *	4.2	27	2.48	None.	6.8	7.93
Aug. 16,	No flower stalks in sight, *	5.8	24	4.06	None.	9.0	11.10
Aug. 20,	Flower stalks developed,*	7.9	24	3.47	2.15	7.0	13.00
Aug. 24,	Flowers open,*	8.7	23	3.70	3.00	4.0	14.07
Aug. 27,	Plants in full bloom,*	10.0	25	3.65	4.13	10.0	15.48
Aug. 30,	Seed forming,*	9.5	30	4.00	3.81	9.5	16.14
Sept. 2,	Seed in milk,*	10.7	27	3.85	4.41	9.5	15.85
Sept. 9,	Seeds still soft,*	12.1	22	3.21	6.86	9.5	26.13
Sept. 9,	Stripped on Sept. 2,*	12.8	22	3.77	6.81	9.5	26.75
Sept. 18,	Left on field without stripping,*	13.2	22	3.57	7.65	-	-
Sept. 18,	Tops removed,*	13.8	22	3.16	8.49	-	-
Sept. 18,	Tops and leaves removed on Sept. 9,*	11.5	22	3.16	5.85	-	-
Sept. 18,	Tops removed; left on field 9 days,*	12.8	22	10.00	.60	-	-
Sept. 21,	Juice from the above,*	13.0	21	-	-	-	-
Sept. 23,	Juice from the above,*	15.0	18	-	-	-	-
Sept. 25,	Left on field 3 weeks,†	19.8	21	11.91	6.27	-	-
Sept. 28,	Left on field 3 weeks,†	17.8	12	16.60	-	-	-
Oct. 4,	Left on field 3 weeks,†	16.1	17	8.62	6.16	12.0	-
Oct. 7,	Freshly cut. Ground with leaves,†	16.7	20	4.16	9.94	6.8	-
Oct. 8,	Freshly cut. Stripped two weeks,†	12.8	17	5.16	5.27	7.0	-
Oct. 9,	Freshly cut. Stripped two weeks,†	18.4	17	7.57	-	10.6	-
Oct. 14,	Several weeks old,†	18.2	15	10.42	-	10.4	-
Oct. 18,	Several weeks old,†	15.1	23	7.57	-	-	-
Oct. 19,	Several weeks old,†	15.5	15	9.22	-	13.6	-
Oct. 22,	Several weeks old,†	16.2	16	8.30	-	-	-
Oct. 23,	Several weeks old,†	18.3	17	11.30	5.5	14.0	-
Oct. 24,	Several weeks old,†	16.6	15	8.63	-	9.0	-

		100 Parts of Cane contained —				
		Moisture.	Glucose.	Cane Sugar.	Total Sugar.	
1889.						
October,	Early Tennessee sorghum, mature,	77.43	1.79	3.21	5.00	Grown on station grounds.
October,	Price's new hybrid, ripe,	77.80	2.92	3.78	6.70	
October,	Kansas orange, green,	80.67	2.38	3.63	6.01	
October,	New orange, green,	78.30	2.96	3.85	6.81	
October,	Honduras, green,	77.55	3.08	4.01	7.09	

* Raised on the college farm. † Raised by farmers in the vicinity of the college.

D. Analyses of Sugar-producing Plants — Concluded.

[Composition of the juice of corn stalks and melons.]

VARIETY.	Specific Gravity.	Temperature C. (Degrees).	Glucose.	Cane Sugar in Juice.	Solids.
			Per ct.	Per ct.	Per ct.
Northern corn,*	1.023	27	4.35	0.28	15.18
Black Mexican sweet corn,†	1.048	27	2.06	7.02	17.44
Evergreen sweet corn,†	1.052	–	4.85	5.70	20.38
Common sweet corn,‡	1.035	–	6.60	None.	–
Common yellow musk-melon,§	1.040	26	1.67	2.65	–
White-flesh water-melon,	1.025	18	2.91	2.16	–
Red-flesh water-melon,	1.025	22	3.57	2.18	–
Red-flesh water-melon,	1.025	19	3.84	1.77	–
Nutmeg musk-melon,‖	1.030	19	3.33	2.11	–
Nutmeg musk-melon,¶	1.050	20	2.27	5.38	–
Nutmeg musk-melon,**	1.030	19	2.50	1.43	–

* Tassels appearing.
† Ears ready for the table.
‡ Kernels somewhat hard.
§ Fully ripe.
‖ Not ripe.
¶ Ripe.
** Over-ripe.

E. *Analyses of Dairy Products.*

	Analyses.	Solids.			Fat.			Curd.			Salt.			Ash.
		Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	
Whole milk,	899	18.27	10.58	13.60	7.54	2.48	4.00	-	-	3.20	-	-	-	.70
Skim milk,	76	10.40	7.68	9.50	1.02	.20	.45	-	-	3.53	-	-	-	.80
Buttermilk,	18	9.86	7.40	8.16	.38	.15	.21	-	-	2.79	-	-	-	.80
Cream (from Cooley Creamer),	94	29.35	21.30	25.50	20.90	13.74	17.70	-	-	-	-	-	-	.62
Butter,	24	92.89	87.05	89.17	89.05	81.43	83.98	.89	.51	.66	6.45	3.61	4.80	-
Whole-milk cheese (Jersey),*	1	-	-	62.84	-	-	37.32	-	-	22.13	-	-	-	3.39
Whole-milk cheese,*	1	-	-	64.17	-	-	34.34	-	-	26.69	-	-	-	3.14
Cheese from milk skimmed after twelve hours' standing,*	1	-	-	62.70	-	-	27.81	-	-	30.37	-	-	-	4.52
Cheese from milk skimmed after twenty-four hours' standing,*	1	-	-	57.76	-	-	23.42	-	-	31.99	-	-	-	2.35
Cheese from milk skimmed after thirty-six hours' standing,*	1	-	-	56.05	-	-	17.67	-	-	33.24	-	-	-	5.14
Cheese from milk skimmed after forty-eight hours' standing,*	1	-	-	54.59	-	-	15.77	-	-	34.94	-	-	-	3.88
Cheese from skim-milk, with addition of buttermilk,*	1	-	-	51.62	-	-	18.35	-	-	28.63	-	-	-	4.64
Genuine oleomargarine cheese,*	1	-	-	62.10	-	-	31.66	-	-	25.94	-	-	-	4.50

* From analyses made in 1875.

E. *Salt for Meat Packing and Dairy Purposes.*

KIND AND SOURCE.	Moisture, 100° C.	Sodium Chloride.	Calcium Sulphate.	Calcium Chloride.	Magnesium Chloride.	Sodium Sulphate.	Magnesium Sulphate.	Insoluble Matter.	Remarks.
Rock salt of Pettite Anse, La.,	.330	98.882	.782	.004	.003	-	-	-	Sent on for examination.
Rock salt of Neyba, San Domingo, W. I.,	.300	98.330	1.480	-	.090	.070	.070	-	
Solar salt, Onondaga, N. Y.,	2.500	96.004	1.315	.092	.089	-	-	-	
Solar salt, Hocking Valley, O.,	2.130	97.512	None.	.234	.089	-	-	-	
Solar salt, Saginaw Valley, Mich.,	3.344	95.813	.316	.356	.140	-	-	-	
Solar salt from Kansas,	4.950	93.060	1.220	-	.240	.350	.180	-	
Solar salt, Lincoln County, Neb.,	1.200	98.130	.250	-	.080	.390	None.	-	
Common fine and boiled salt, Onondaga, N. Y.,	3.000	95.353	1.355	.155	.136	-	-	-	
Common fine and boiled salt, Portsmouth, Mich.,	6.752	90.682	.805	.974	.781	-	-	-	
Common fine and boiled salt, Mason City, O.,	3.470	95.789	-	.614	.041	-	-	-	
Dairy and table salt, Ashton's (English),	0.760	97.652	1.430	-	.060	-	.048	.050	
Onondaga dairy salt,	0.700	97.832	1.263	-	.037	.026	.023	.120	
Fine salt, Bulletin 26, I.,	3.280	95.091	1.487	.032	.075	-	-	.035	
Fine salt, Bulletin 26, II.,	4.591	94.012	1.177	.143	.049	-	-	,028	
Fine salt, Bulletin 26, III.,	4.616	94.236	.999	.071	.026	-	-	.052	Salicylic acid: trace.
Dairy salt, sent on from Amherst, Mass.,	0.145	98.520	1.009	.189	.065	-	-	.072	
Ashton salt (sent on),	.760	97.650	1.430	-	.060	-	.050	.050	
Onondaga factory-filled (sent on),	.600	98.280	.910	-	-	.030	.060	.120	
Dairy salt, sent on from Amherst,	.505	98.202	.877	.168	.046	-	-	.202	
Rock salt from Retsof salt mines,	2.600	95.940	.420	.330	.010	-	-	.700	
Royal salt,	.880	97.877	1.108	.016	.010	-	-	.102	
Excelsior salt,	.320	98.009	1.644	.013	.014	-	-	.020	
Genesee salt,	.295	98.513	1.160	.010	.012	-	-	.010	
Genesee salt,	.235	98.563	1.137	.045	.020	-	-	-	
Bradley salt,	.200	98.575	1.185	.029	.007	-	-	-	
Higgins' Eureka salt,	.855	98.891	.906	.293	.055	-	-	-	
Worcester refined salt,	.565	97.935	1.376	.097	.027	-	-	-	

F. Analyses of Insecticides.

	Moisture.	Arsenious Oxide.	Copper Oxide.	Acetic Acid.	Nicotine.	Mercury.	Sulphur.	Sulphuric Acid.	Chlorine.	Calcium Oxide.	Potassium Oxide.	Ferric and Aluminic Oxides.	Insoluble Matter.
Paris green,	1.30	62.55	32.84	3.10	-	-	-	-	-	-	-	-	0.21
Paris green,	1.41	61.40	33.20	3.90	-	-	-	-	-	-	-	-	0.09
Paris green,	1.40	61.15	33.10	3.71	-	-	-	-	-	-	-	-	0.64
Paris green,	1.15	59.92	30.40	-	-	-	-	-	-	-	-	-	0.10
Paris green,	1.34	61.25	33.35	3.93	-	-	-	-	-	-	-	-	0.13
Paris green,	1.31	61.21	33.45	3.94	-	-	-	-	-	-	-	-	0.09
"Sulphatine,"	1.40	-	2.61	-	-	-	48.28	4.73	-	18.60	-	-	1.63
"Death to Rose Bugs,"	2.95	-	1.05	-	-	-	34.53	4.35	-	17.76	-	-	0.49
"Professor De Graff's Carpet Bug Destroyer,"	95.81	-	-	-	-	0.78	-	0.48	0.27	-	0.26	0.90	-
Tobacco liquor,	37.71	-	-	-	2.12	-	-	-	-	3.07	6.55	0.23	-
Tobacco liquor,	40.89	-	-	-	0.53	-	-	-	-	1.47	16.34	0.01	-
Tobacco liquor,	-	-	-	-	4.55	-	-	-	-	-	-	-	-
Tobacco liquor,	-	-	-	-	4.82	-	-	-	-	-	-	-	-
"Nicotinia,"	10.00	-	-	-	-	-	-	-	-	4.45	9.15	-	2.12
Hellebore,	-	-	-	-	-	-	-	-	-	-	-	-	2.34
Hellebore,	-	-	-	-	-	-	-	-	-	-	-	-	38.12
"Peroxide of Silicate,"	1.65	0.57	0.33	-	-	-	-	49.66	-	41.18	-	-	2.31

METEOROLOGY.

1891.

The meteorological observations have been continued as in previous years. The temperature, the force and the direction of the wind and the amount of cloudiness are recorded each day at 7 A.M., 2 P.M. and 9 P.M. During the summer months the reading of a wet-bulb thermometer takes place at the same times. Records are also taken of maximum and minimum temperatures, rainfall, and of casual meteorological phenomena.

Monthly and annual reports are sent to the headquarters of the signal service at Washington, D. C., and to the New England Meteorological Society. During the summer months partial monthly reports have been furnished also for the use of the secretary of the State Board of Agriculture.

At the beginning of the year there were nine inches of snow on the ground. The total snowfall of the season after January 1 amounted to fifty-eight inches. The heaviest snow-storm during the time occurred January 25, measuring thirteen inches. A storm giving twelve inches of snow occurred on the 3d and 4th of March. The last snow of this part of the season fell on the 2d and 3d of April. Sleighing was good most of the time until the 10th of March. A snow-storm on the 26th of November amounted to one and one-half inches. The snowfall during December was very light. The precipitation of moisture (rain and snow) during the year was below the average and unevenly distributed.

The largest amount of water falling in one month was 6.61 inches, January; the smallest amount 1.98 inches, November. The heaviest storm of the year occurred from the 2d to the 4th of June, with 2.92 inches of rainfall. The largest amount of rain falling in any one day was 1.73 inches, June 2.

The rainfall during April and May was light, otherwise the early part of the season was favorable for farm crops. The large number of rainy days during July and August interfered to some extent with haying and harvesting. The rainfall for the months September, October and November was much below the usual average. A scarcity of water was seriously felt in many localities of this vicinity.

The last heavy frost of the season occurred on the 19th of May; there was a slight one on the 5th of June. No frost was noticed in the autumn before October 10.

The mean annual temperature for the year was 47.62° F., which is slightly above the average. The monthly average temperatures did not vary much from those of former years except during September, which was considerably warmer than usual.

The highest temperature for the year, 93° F., occurred June 16; the lowest, —5.5, February 15.

The prevailing wind during six months of the year came from the north-east. It was north-west during April and May, south during July, and south-east during September, November and December.

During the year there were one hundred and forty-five days recorded as "cloudy," seventy-nine as "cloudless." The greatest number of cloudy days, fifteen, occurred in January, and the greatest number of cloudless days, eight, in November and December.

Summary of Meteorological Observations, 1891.

	TEMPERATURE, DEGREES FAHRENHEIT.											RELATIVE HUMIDITY, PER CENT.				PRECIPITATION, INCHES.	
	7 A. M.	2 P. M.	9 P. M.	Mean.	Maximum.	Minimum.	Range.	Absolute Maximum.	Date.	Absolute Minimum.	Date.	7 A. M.	2 P. M.	9 P. M.	Mean.	Depth of Water.	Date of Greatest Fall.
January, ...	21.7	30.3	26.6	26.3	41.5	14.4	27.1	50.5	22d	—1.0	10th	-	-	-		6.61	22d
February, ...	23.4	32.1	27.2	27.5	47.9	10.4	37.5	53.5	25th	—5.5	15th	-	-	-	-	3.84	9th, 10th
March, ...	27.2	37.7	31.7	32.1	44.5	10.2	34.3	55.5	29th	—1.0	2d	-	-	-	-	2.89	8th, 9th
April, ...	41.6	55.2	45.4	46.9	64.0	10.8	33.2	77.0	30th	18.0	6th	-	-	-	-	2.74	11th
May, ...	49.3	64.4	53.4	55.2	68.1	37.4	37.0	86.0	10th	25.0	6th	79.0	56.2	71.5	68.9	1.82	29th
June, ...	59.6	74.6	62.8	64.9	77.1	49.3	27.8	93.0	16th	34.5	5th	87.7	60.8	80.2	76.2	4.61	2d
July, ...	61.7	74.2	64.4	66.2	76.2	58.6	17.6	89.0	13th	42.0	28th	87.4	62.4	81.9	77.2	5.09	30th
August, ...	63.9	76.3	66.6	68.3	77.4	58.8	18.6	90.0	11th	46.0	1st	90.9	66.1	86.6	81.2	3.67	28th
September, ...	57.8	73.0	61.7	63.6	75.0	50.5	24.5	89.0	18th	37.0	9th	95.7	64.4	87.4	82.5	2.22	29th
October, ...	41.4	56.8	46.0	47.5	67.2	33.0	34.2	87.0	4th	21.0	29th	88.4	62.6	82.5	77.8	2.56	20th
November, ...	32.3	45.1	35.2	37.0	56.0	14.6	41.4	63.0	11th	4.0	30th	-	-	-	-	1.98	16th, 17th
December, ...	31.0	42.3	35.2	35.9	52.9	12.8	40.1	58.5	4th	9.0	17th	-	-	-	-	4.55	29th, 30th
Sums, ...	510.9	662.0	556.2	571.4	747.8	380.8	367.0	892.0	-	229.0	-	529.1	372.5	490.1	463.8	42.58	-
Mean, ...	42.57	55.17	46.35	47.62	62.32	31.73	30.58	74.33	-	19.08	-	88.18	62.08	81.68	77.30	3.55	-

Miscellaneous Phenomena, — Dates.

	Frost.	Snow.	Rain.	Thunder-storms.	Lunar Halos.	Solar Halos.
1891.						
January, . .	–	1, 5, 14, 17, 18, 25, 27, 29.	1, 11, 12, 17, 18, 22, 29, 31.	2,	15,	–
February, . .	–	7, 8, 9, 20, 26,	1, 3, 9, 10, 16, 17, 18, 21, 25.	–	15, 19,	6, 28.
March, . .	–	3, 4,	8, 9, 12, 13, 21, 22.	–	18,	27, 31.
April, . .	–	2, 3,	11, 14,	15, 18,	–	–
May, . .	19,	–	3, 6, 15, 16, 21, 29.	11, 26,	20,	2.
June, . .	5,	–	4, 17, 18, 19, 21, 22.	2, 3,	11,	–
July, . .	–	–	4, 7, 8, 18, 24, 28, 29, 30.	15, 25,	–	–
August, . .	–	–	4, 5, 21, 22, 23, 24, 26, 27.	7, 12, 15, 18, 25.	–	–
September, .	–	–	5, 6,	13, 29,	11,	–
October, .	10, 12, 16, 17, 24, 25, 29, 30.	–	7, 8, 13, 26, 27,	20,	–	–
November, .	3, 4, 5, 7, 8, 13, 14, 15, 19, 20, 21, 26.	26,	10, 11, 16, 17, 23, 26, 27, 28.	–	19,	–
December, .	1, 12, 13, 28, 29.	–	4, 7, 15, 16, 22, 23, 24, 26, 29, 30.	–	9, 19,	–

AMHERST, MASS.

C. A. GOESSMANN,
Director.

ANNUAL REPORT OF FRANK E. PAIGE,

TREASURER OF THE MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION,

For the Year ending Dec. 31, 1891.

RECEIVED.		
Cash on hand from last year,	$343 86	
Cash from State Treasurer, appropriation,	10,000 00	
Cash from fertilizer account,	2,250 00	
Cash from expense,	325 00	
Cash from farm,	978 71	
		$13,897 57
EXPENDED.		
Cash paid salaries,	$5,243 31	
Cash paid laboratory supplies,	738 43	
Cash paid printing and office expenses,	680 75	
Cash paid farmer and farm labor,	2,330 24	
Cash paid farm supplies,	1,505 47	
Cash paid incidental expenses,	528 66	
Cash paid construction and repairs,	138 77	
Cash paid expense of board of control,	138 63	
Cash paid fertilizer account,	2,590 00	
Cash on hand,	3 31	
		$13,897 57

SUMMARY OF THE PROPERTY OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

(Dec. 31, 1891.)

Farm:		
Live stock,	$821 00	
Tools, implements and machinery,	935 95	
Produce on hand,	607 20	
Fertilizers,	72 67	
Chemical Laboratory:		
Laboratory inventory,	2,740 27	
Office furniture,	1,617 00	
Agricultural and Physiological Laboratory:		
Furniture, herbariums, library (first floor),	734 75	
Instruments, apparatus, etc. (first floor),	691 20	
Furniture (second floor),	394 52	
Instruments, apparatus, etc. (second floor),	369 90	
Buildings, land, etc.,	32,202 00	
Total of inventory,		$41,186 46

BOSTON, MASS., Jan. 14, 1892.

This is to certify that I have examined the books and accounts of Frank E. Paige, Treasurer of the Massachusetts Agricultural Experiment Station, for the fiscal year ending Dec. 31, 1891, and find them correct, and all disbursements properly vouched for, with a balance in the treasury of three dollars and thirty-one cents, which is shown to be in bank.

W. R. SESSIONS,
Auditor.

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